

Nanocompósitos para adesão e anti-aderência

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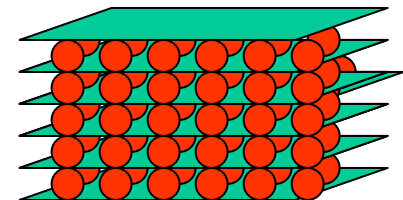
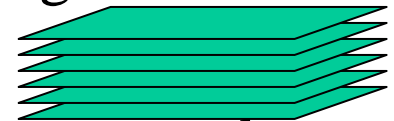
Instituto do Milênio de Materiais Complexos

Já sabemos tudo? Não!

- Ignoramos o que existe em superfícies, em diferentes ambientes
 - Portanto não entendemos muitos comportamentos de superfícies
 - E ainda temos muitos problemas de adesão/não-adesão
- Ignoramos quais são os “personagens” da Eletrostática:
 - Onde se localizam as cargas elétricas em um plástico, vidro ou cerâmica eletrizados?
 - Quais são e como se distribuem as cargas estáticas nesse ambiente?

Um fiasco histórico

- Grafite é um excelente lubrificante
- Equipamentos lubrificados com grafite apresentaram muitas falhas, em satélites
- Por que?
 - Pensava-se que a coesão entre lâminas de grafite é muito baixa.
 - ...mas isso só acontece na atmosfera terrestre, onde moléculas de gases se intercalam entre as lâminas.



Consertando o fiasco

- Solução: procurar outros compostos lamelares que tenham muito pouca adesão entre as lamelas.
 - MoS_2 , WS_2
- Outra solução: procurar compostos de intercalação de grafite com substâncias não-voláteis.

Um sucesso histórico

- Teflon: dos mancais às frigideiras
 - Por que funciona tão bem?
 - Propriedades químicas, propriedades de superfície, propriedades mecânicas das cadeias
- ...mas também apresenta problemas
 - Desgaste
 - Custos
 - Dificuldades de conformação e aplicação
- Consequência: precisamos de novos sucessos

ADHESION AND DE-ADHESION MECHANISMS AT POLYMER/METAL INTERFACES

G. Grundmeier and -M. Stratmann

Annual Review of Materials Research vol. 35: 571-615

Max-Planck Institute for Iron Research; Christian-Doppler-Laboratory for
Polymer/Metal Interfaces

- Spectroscopic, microscopic, and electrochemical techniques to **improve the understanding** of the interaction of organic molecules with metal surfaces.
- **Chemical and electrochemical processes** and de-adhesion .
- **Molecular understanding** of organic molecules and water at buried metal surfaces.
- **Atomic force microscopy, scanning Kelvin probe.**
- Effects of **humid and corrosive environments**, the most important for metal/polymer composites in engineering applications.

Quem quer anti-aderência?

- 6,599,594 Glass container for medicinal purposes
- 6,475,523 Powders comprising anti-adherent materials for use in dry powder inhalers
- 6,368,436 Method of making transfer surface
- 6,224,910 Method for the preparation of an enteric coated high drug load pharmaceutical composition
- 6,163,959 Method of reducing the gap between a liner and a turbine distributor of a turbojet engine
- 6,027,789 Surface for the transfer of a viscous liquid to a support and offset printing blanket including the surface
- 5,928,746 Method and apparatus for manufacturing a crack repair product and repairing a crack using the product
- 5,819,505 Process for continuous abherent treatment of a surface adherent holt-melt adhesive
- 5,225,202 Enteric coated pharmaceutical compositions
- 4,806,139 Permanent anti-adherent coating for glassmaking moulds and associated equipment
- 4,526,640 Equipment for producing continuous tape of rubbery vulcanizable material for the manufacture of hose articles
- 4,215,459 Method of removing hose from a mandrel and a mandrel adapted to the method

Adesão de água em madeira

- Como se faz madeira auto-limpante, não-molhável e resistente ao ataque de fungos?
 - Resposta: com uma camada de material hidrofóbico nano-rugoso e quimicamente estável:



Madeira comum



Madeira nanotecnológica

Moldes anti-aderentes

- Revestimentos estáveis de superfícies de alumínio e outros substratos
 - Institut für Neue Materialien, Saarbrücken
 - Sant-Gobain Glass
 - Sunyx Surface Nanotechnologies (Köln)
 - Superfícies ultra-hidrofóbicas (roll-off angle 10°C)
- Revestimento hidrofóbico
 - aderência + nanorugosidade
- Resultado: ciclos de produção mais rápidos, dispensando (diminuindo) o uso de desmoldantes

Uma solução

- Substrate with an anti-adhesive coating, e.g. useful as a mold release layer, especially for casting metals, has a coating comprising particles of a release agent and a binder comprising surface-modified nanoparticles
- Patent Assignee: INST NEUE MATERIALIEN GEMEINNUETZIGE GMB
- NOVELTY - Substrate with an **anti-adhesive coating** formed by applying a coating composition onto a substrate and curing the coating is new. The coating composition comprises **solid particles of a release agent other than boron nitride and a binder** comprising surface-modified nanoparticles.
- ADVANTAGE - The coating is stable at high temperatures.
 - Graphite, fluorinated graphite, molybdenum disulfide or tungsten disulfide/ silica, titanium dioxide, zirconium dioxide, alumina, alumina hydrate, yttrium oxide, cerium oxide, tin(IV) oxide, iron oxide, or tantalum(V) oxide nanoparticles/ Polysiloxane-based nanocomposite prepared by a sol-gel process in which the nanoparticles are reacted with a silane.

O que é novo?

- Velho: um conhecimento tecnológico “antigo”: nanopartículas de negro de fumo e/ou de sílica são essenciais para se fazer boas borrachas.
- Novo: novas maneiras de se fazer nanopartículas e de juntá-las a polímeros, de diferentes maneiras.

Electropulse nanotechnologies for activation of precision-casting processes.

- Znamenskii, L. G. Yuzhno-Ural. Gos. Univ., Chelyabinsk, Russia. Zagotovitel'nye Proizvodstva v Mashinostroenii (2003), (12), 3-7.
- Max. improvement of casting process is obsd. when nanosecond electromagnetic pulses are applied for treatment of hydrolyzed solns. of ethylsilicate and water glass...recommended for precision casting in space industry, machine building and instrumentation.
- **Revestimento de moldes metálicos com filmes finos de sílica**

Treatment of a surface for generating an antiadherent, thermally stable fluoroalkylsilane coating.

- Mostefai, Malik; Shanahan, Martin E. R.; Meslif, Alain; Fayet, Florence. Fr. Demande (1999), 19 pp. CODEN: FRXXBL FR 2768947 A1 19990402 CAN 131:33028 AN 1999:402147 CAPLUS
- Revestimentos formados por fluoroalquilsilanos e nanopartículas de óxidos de silício, titânio, zircônio e alumínio formados *in situ* a partir de alcóxidos e acetatos/propionatos.

Quem quer adesão?

- Quem usa Velcro, zíper, tintas de qualquer espécie, máquinas de qualquer espécie, materiais compósitos...
- Quem quer fazer um avião com materiais não-condutores.
- Quem quer juntar partes melhor e mais rápido que no seu processo atual.
- ...

Fechos magnéticos

- United States Patent Application 20050102802
- Sitbon, Eric ; et al. May 19, 2005
- Device for fixing to each other or adjusting parts or pieces of clothing or underwear such as bras
- This document applies to a device to maintain in contact, to regulate, adjust or close parts of clothing, undergarments such as bras, garter belts, or any other accessory, and clothing, underclothing, more particularly bras and accessories having such a device.

Revestimentos de material cirúrgico

- United States Patent Application 20040127974
- Mangiardi, Eric K. ; et al. July 1, 2004
- Differential covering and coating methods
- The present invention, in an exemplary embodiment, provides a **stent, which combines many of the excellent characteristics of both silicone and metal stents while eliminating the undesirable ones**. In particular, a principal objective in accordance with the present invention is to provide a family of stents where the relative hardness/softness of regions of the stent can differ from other regions of the stent to provide additional patient comfort and resistance to compression forces.
- Inventors: Mangiardi, Eric K.; (Charlotte, NC) ; Reynolds, Jason M.; (Charlotte, NC) ; Borg, Ulf R.; (Cornelius, NC) ; Alexander, Tony D.; (Charlotte, NC)
- ALVEOLUS INC
- c/o PortfoliоIP

Impressão offset

- United States Patent Application 20030150346
- Haraux, Shophie ; et al. August 14, 2003
- Blanket with variable surface properties for a printing machine
- According to the invention, at least one surface property of the invention, namely the overall surface energy of the blanket, the surface energy with a polar character of the blanket or the average roughness of the blanket varies on the outer surface of the blanket crosswise. The invention is applicable for any indirect printing process, especially offset printing as function.
- Inventors: Haraux, Shophie; (Thann, FR) ; Boukaftane, Chouaib; (Mulhouse, FR) ; Kuczynski, Jerzy; (Zillisheim, FR) ; Zahouil, Khalid; (Lutterbach, FR) ; Decker, Christian; (Rixheim, FR)
- Correspondence Name and Address: John L. Cordani
- Carmody & Torrance, LLP

Rotulagem

- United States Patent Application 20030008082
- Dronzek, Peter J. JR. ; et al. January 9, 2003
- Labels with removable section for in-mold production of in-mold labeled molded containers
- The polymer film is reverse pattern-printed with an adhesive coextensive with the detachable portion then overcoated on the container-facing side with a continuous coating of heat activatable adhesive. The labels are firmly adherent, except for the removable coupon, and squeeze-release resistant and the indicia, because, in clear and contact-clear versions, are viewable through the labels themselves, **are protected against spillage and abrasion.**
- Inventors: Dronzek, Peter J. JR.; (Thornwood, NY) ; Zychowski, Wallace J.; (Norway, MI) ; Bau, Jeffrey P.; (Iron Mountain, MI)
- Correspondence Name and Address: HEDMAN & COSTIGAN, P.C.

Membrana para moldagem de resina por transferência

- United States Patent Application 20020182327
- Fournier, Alain December 5, 2002
- Process for the protection of flexible silicone membranes, particularly in the case of molding by resin transfer
- Process for treating a flexible bi-constituent self-demolding silicone membrane used as a counterform particularly for resin transfer molding. The membrane is coated with a thin layer of at least one monoconstituent silicone which is a polysiloxane cross-linkable at ambient temperature in the presence of the moisture in air. The polysiloxane corresponds to the formula (I): 1 in which: the substituents R.sup.3, R.sup.4, and R.sup.5 are selected from alkyl or aryl radicals, R.sup.6 represents an alkyloxy group, an alkenyloxy group, an alcanoyloxy group, an amino group, a ketiminoxy group, an amido group, an aminoxy group.
- Inventors: Fournier, Alain; (Saint Lys, FR)
- Correspondence Name and Address: YOUNG & THOMPSON

Nanoparticle-based permanent treatments for textiles

- United States Patent 6,607,994
- Soane et al. August 19, 2003
- This invention is directed to preparations useful for the permanent or substantially permanent **treatment of textiles and other webs. The payload nanoparticle will form a chemical covalent bond with the substrate to be treated.** The polymeric encapsulator of the payload nanoparticle has a surface that includes functional groups for binding or attachment to the fibers of the textiles or other webs to be treated, to provide permanent attachment of the payload to the textiles. Such textiles and webs exhibit a greatly improved retention or durability of the payload agent and its activity, even after multiple washings.
- Inventors: Soane; David S. (Piedmont, CA); Offord; David A. (Castro Valley, CA); Linford; Matthew R (Orem, UT); Millward; Dan B. (Alameda, CA); Ware, Jr.; William (Palo Alto, CA); Erskine; Lael (Fremont, CA); Green; Eric (Oakland, CA); Lau; Ryan (Berkeley, CA)
- Assignee: Nano-Tex, LLC (Emeryville, CA)
- Appl. No.: 731431
- Filed: December 6, 2000

Production of fluoropolymer film for **non-stick surface treatment**, e.g. **textile coating**, involves pouring thermoplastic fluoropolymer onto a polar substrate, removing before crosslinking and applying the film to a surface

- Patent Number(s): DE10106779-A1
- JONSCHKER G, NANOGATE GMBH
- NOVELTY - A method for the production of fluoropolymer film for the non-stick modification of surfaces involves pouring a thermoplastic polymer (I) onto a polar substrate, removing (I) before crosslinking with the substrate occurs and then applying the resulting fluoropolymer film to the surface to be modified.
- USE - Fluoropolymer film obtained by this method is used for coating textiles and for the non-stick modification of components (claimed).
- ADVANTAGE - Enables the production of uncrosslinked fluoropolymer film which can be subjected to appropriate forming operations and then crosslinked (e.g. on a substrate) to form a duroplastic coating with good abrasion resistance, good water- and soil-resistance and permanent anti-adhesive (non-stick) properties.
- **Fluoropolymer** (I) obtained from (meth)acrylic-functional silane. Nano-particles of various composition, shape and structure may also be added to (I): **silicon dioxide, oxides of titanium, zirconium and aluminum, aluminum oxide-hydroxide and metal salts or alkoxides (especially salts and alkoxides of Ti, Zr, Al, boron, tin, chromium, manganese and iron).**

Manufacturing of a thin film inorganic light emitting diode

- United States Patent 6,737,293
- Andriessen May 18, 2004
- Abstract
- Nanoparticle dispersions of ZnS doped with a luminescent center are prepared by precipitation from aqueous solutions. When such dispersions are coated between conductive electrodes a **Thin Film Inorganic Light Emitting Diode** device is obtained.
- Inventors: Andriessen; Hieronymus (Beerse, BE)
- Assignee: AGFA-Gevaert (Mortsel, BE)
- Appl. No.: 050667
- Filed: January 16, 2002

Revestimento anti-abrasivo de endurecimento ultra-rápido

- KIM D G (KR)
- Abstract: NOVELTY - Provided are an **ultra high speed hardening type anti-abrasive material** which has excellent wear-resistance to an internal wall of a casing, adhesion and chemical resistance, thereby improving the durability of the casing, and is **convenient in repair and construction**, and a coating method thereof.
- DETAILED DESCRIPTION – Poliuretano com nanopartículas.

Nanoparticles having oligonucleotides attached thereto and uses therefor

- United States Patent 6,903,207, June 7, 2005
Abstract. The invention provides methods of detecting a nucleic acid. The methods comprise contacting the nucleic acid with one or more types of particles having oligonucleotides attached thereto... A detectable change (preferably a color change) is brought about as a result of the hybridization of the oligonucleotides on the nanoparticles to the nucleic acid. The invention also provides compositions and kits comprising particles. The invention further provides methods of synthesizing unique *nanoparticle*-oligonucleotide conjugates...In addition, the invention provides nanomaterials and nanostructures comprising nanoparticles and methods of nanofabrication utilizing nanoparticles. **Finally, the invention provides a method of separating a selected nucleic acid from other nucleic acids.**
- Inventors: Mirkin; Chad A. (Wilmette, IL); Letsinger; Robert L. (Wilmette, IL); Mucic; Robert C. (Glendale, CA); Storhoff; James J. (Evanston, IL); Elghanian; Robert (Skokie, IL); Taton; Thomas A. (Little Canada, MN)
- Assignee: Nanosphere, Inc. (Northbrook, IL)
- Filed: October 12, 2001

Coating composition for **anti-adhesive coating of bandages**, to prevent sticking to wounds, comprises a nano-sol containing silicon oxide and at least one hydrophobic organosilicon compound

- Patent Number(s): DE10249874-A1; WO2004037139-A1; AU2003301644-A1
- MAHLTIG B, BOETTCHER H, LANGEN G, MEISTER M, BOTTCHER H, GES FOERDERUNG VON MEDIZIN BIO & UMWELTT (FOER-Non-standard)
- HARTMANN AG PAUL (HARN)
- NOVELTY - A coating composition (I) for the anti-adhesive coating of bandages consists of a nano-sol containing (A) silicon oxide and (B) at least one hydrophobic organic silicon compound.
- USE - For coating bandages in order to reduce the adhesion between wound and bandage (claimed).
- ADVANTAGE - A cost-effective coating material which can be applied to various types of bandage materials (including single-layer bandages) to reduce the adhesion between wound and bandage (and therefore to prevent damage to the healing wound when the bandage is changed). Hydrophilic components may also be added to produce bandages with a hydrophobic surface and reduced adhesion combined with good liquid absorption properties.

Easily cleaned apparatus for use in **cooking or food processing** has an inconspicuous, anti-adhesive layer of metal oxide containing a hydrophobic substance

- Patent Number(s): EP1391249-A; EP1391249-A1; DE10236728-A1; CA2436871-A1; JP2004130785-A; US2004105985-A1; CN1494952-A; US2004209072-A1
- HENZE I, KLIPPE L, KRAUSE C, METZ B, DZICK J, SCHULTHEIS B, SCHOTT GLAS (ZEIS), ZEISS STIFTUNG CARL (ZEIS)
- NOVELTY - Apparatus has a 1-1000 nm thick anti-adhesive layer which is easily cleaned and which is heat resistant at at least 300°C, the layer containing a **metal oxide network with a hydrophobic substance** homogeneously distributed throughout the thickness; and being markedly hydrophobic and having a water contact angle above 90 degrees.
- USE - In cooking equipment (or parts thereof), especially ovens, ceramic hobs, microwave devices, grills, extractor hoods, mixers, hand-held blenders for puree, food vessel or baking tray or mold (all claimed).
- ADVANTAGE - **The apparatus is easily cleaned while being abrasion resistant and unaltered in appearance.**

Mold tool manufacturing used for **nano-imprinting on disk**, involves applying reagent comprising molecule chains having linkage group, on oxide film formed by oxidizing metal layer

- Patent Number(s): WO2004000567-A1; SE200201917-A; SE523095-C2; AU2003239022-A1; EP1513688-A1
- LING T, MONTELIUS L, KEIL M, BECK M, OBDUCAT AB
- NOVELTY - A stamp blank with a structured pattern is provided on a stamp surface before depositing a layer of metal having stable oxidation number on the patterned surface. **Reagents comprising molecule chains having a linkage group, is applied on an oxide film formed by oxidizing the metal layer.** The chains include a group comprising fluorine either at outset or in subsequent treatment.
- USE - For manufacturing mold tool used for transferring structured nanoscale patterns on storage medium e.g. compact disk (CD), digital versatile disk (DVD) in nano-imprint lithography.
- ADVANTAGE - By using simple and reliable method, mold tool having stable anti-adhesive layer with good adhesive characteristics is manufactured easily.

O que é realmente novo

- Um domínio cada vez mais fino de estruturas complexas, formadas por metais, óxidos e polímeros.
- Formação de redes muito coesas, com rugosidade muito bem controlada.
- Controle de interações entre superfícies
 - Repulsões e atrações controladas com alta resolução espacial

Há várias outras abordagens

- Outros materiais
- Outros processos
- Sempre com o mesmo objetivo

Fabricação de circuitos impressos

- Cima NanoTech
 - Aveka (subsidiária 3M, US) + Nanopowder Inds. (IL)
- Nanopartículas para tintas inkjet e revestimentos condutores transparentes
- Patentes: nanopartículas e ligas nanometálicas
 - **Plataforma para fabricantes de circuitos e dispositivos eletrônicos**

Micro-moldagem

- WO200000868-A; WO200000868-A1; US6309580-B1; ... 2000-126842
- Improving release properties of a surface for processes of **molding and micro-replication of ultra fine features in a thin film** carried on a surface of a substrate
- UNIV MINNESOTA (MINU); CHOU S Y (CHOU-Individual)
- CHOU S Y

Molding and micro-replication of ultra fine features in a thin film

- Patent Number(s): WO200000868-A; WO200000868-A1; US6309580-B1; CN1309784-A; US2002167117-A1; US2003034329-A1; US2003080471-A1; US2003080472-A1
- CHOU S Y, UNIV MINNESOTA
- NOVELTY - Properties of a surface are improved by contacting the surface with a release forming material that is a non-continuous coating that does not bond cohesively with itself parallel to the surface. This material instead bonds with the **surface molecule-by-molecule**.
- USE - Processes of molding and microreplication to create patterns with ultra fine features in a thin film carried on surface of a substrate. Lithography.
- ADVANTAGE - Eliminates many resolution limitations of prior art lithography such as wavelength limitation, backscattering of particles in the resist and substrate, and optical interference. It offers a finer lithography resolution and much more uniform lithography over the entire substrate. **It can provide a high throughput mass production lithography method for generating sub-25 nm features and it can mass produce sub-10 nm features at a low cost.**

Thermal spray method for the formation of nanostructured coatings

- United States Patent 6,277,448
- Strutt , et al. August 21, 2001
- This invention relates to methods whereby nanoparticle precursor solutions are used in conventional thermal spray deposition for the fabrication of high-quality nanostructured coatings. **The method allows combining nanoparticle synthesis, melting, and quenching into a single operation.**
- Inventors: Strutt; Peter R. (Storrs, CT); Kear; Bernard H. (Piscataway, NJ); Boland; Ross F. (West Hartford, CT)
- Assignee: Rutgers the State University of New Jersey (Piscataway, NJ); University of Connecticut (Storrs, CT)
- Appl. No.: 325822
- Filed: June 4, 1999

Engine component for vehicles has a surface coated in certain areas with an anti-adhesion layer of amorphous and/or quasi-crystalline metal

- Patent Number(s): WO2004063412-A1; DE10301390-A1
- HEUBERGER A, HUBER H, SAGEL A, DAIMLERCHRYSLER AG (DAIM)
- NOVELTY - Engine component has a surface coated in certain areas with an anti-adhesion layer of **amorphous and/or quasi-crystalline metal**.
- USE - For vehicles. ADVANTAGE - Accumulated deposits of engine sludge are avoided.
- Preferred Features: The quasi-crystalline metal is an alloy based on aluminum. The anti-adhesion layer additionally has a solid lubricant. The amorphous metal is an alloy based on aluminum, tantalum-silicon, titanium and/or iron and has a nano- to micro-crystalline secondary phase containing a ceramic or intermetal.

Design de um produto nanotecnológico: nanocompósito

- Gerar novos materiais poliméricos através da Nanotecnologia



polímero | + argila



nanocompósito

- Separar lâminas de filosilicato, dispersar e orientar as lâminas em matriz de polímero.
- A permeabilidade do polímero a gases pode ser reduzida a 10% ou menos.
- A resistência do polímero à flexão diminui: aumento da temperatura de trabalho.
- Coeficiente de armazenamento elástico aumenta.

437 patentes no USPTO <nanocomposite and polymer>: 50 entre 30/3 e 17/8/2004

- [6,777,480 Networked polymer/clay alloy](#)
- [6,777,479 Polyamide nanocomposites with oxygen scavenging capability](#)
- [6,773,823 Sequential synthesis of core-shell nanoparticles using reverse micelles](#)
- [6,770,697 High melt-strength polyolefin composites and methods for making and using same](#)
- [6,765,049 High acid aqueous nanocomposite dispersions](#)
- [6,764,617 Ferromagnetic conducting lignosulfonic acid-doped polyaniline nanocomposites](#)
- [6,762,237 Nanocomposite dielectrics](#)
- [6,762,233 Liquid crystalline composites containing phyllosilicates](#)
- [6,759,446 Polymer nanocomposite foams](#)
- [6,758,148 Fire blocking method and apparatus](#)
- [6,757,094 Optical shutter assembly](#)
- [6,756,444 Oxygen scavenging polyamide compositions suitable for pet bottle applications](#)
- [6,753,360 System and method of preparing a reinforced polymer by supercritical fluid treatment](#)
- [6,750,282 Flameproof polymer composition](#)

- Sequestro de oxigênio (cerveja)
- Fundido resistente
- Condutor ferromagnético
- Dielétrico
- Espuma sólida
- Anti-chama
- Processamento supercrítico
- Filme fino resistivo
- Meio para registro de imagens, detector de radiação, guias de onda, registro magnético, memória ótica 3D, chaves ópticas, membranas, eletrodos, catalisadores...

[54] **BARRIER COATING OF AN ELASTOMER AND A DISPERSED LAYERED FILLER IN A LIQUID CARRIER**

[75] **Inventors:** Carrie A. Feeney, Bridgewater, N.J.; Michele Farrell, Bethlehem, Pa.; Klaus Tannert, Nordrhein-Westfalen, Germany; Harris A. Goldberg, Edison; Mengshi Lu, North Plainfield, both of N.J.; Michael D. Grab; William G. Steiner, both of Simpsonville, S.C.; Paul B. Winston, Greer, S.C.

[73] **Assignees:** InMat, LLC, N.J.; Michelin Recherche et Technique S.A., Switzerland

[21] **Appl. No.:** 09/093,332

[22] **Filed:** Jun. 8, 1998

Related U.S. Application Data

[63] Continuation-in-part of application No. 08/871,574, Jun. 9, 1997, abandoned.

[51] **Int. Cl.⁷** C09D 1/02; C09D 5/02

[52] **U.S. Cl.** 428/454; 427/245; 427/412.3; 524/441; 524/446; 524/447; 524/448; 524/449; 524/450; 524/791; 524/836; 524/856; 523/166

[58] **Field of Search** 428/402, 454; 524/447, 449, 791, 836, 856, 446, 448, 450, 441; 523/166; 427/245, 412.3

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Primary Examiner—Veronica P. Hoke
Attorney, Agent, or Firm—Howson and Howson

[57] **ABSTRACT**

Barrier coating mixtures contain in a carrier liquid, (a) an elastomeric (preferably butyl-containing) polymer; (b) a dispersed exfoliated layered filler having an aspect ratio greater than 25; and (c) at least one surfactant, wherein the solids content of the mixture is less than 30% and the ratio of polymer (a) to filler (b) is between 20:1 and 1:1. Coated articles, which are rigid or flexible and elastomeric, and free-standing films and membranes, which are flexible and elastomeric, are produced using the barrier coating mixtures.

Barrier coating mixtures contain in a carrier liquid, (a) an elastomeric (preferably butyl-containing) polymer; (b) a dispersed exfoliated layered filler having an aspect ratio greater than 25; and (c) at least one surfactant, wherein the solids content of the mixture is less than 30% and the ratio of polymer (a) to filler (b) is between 20:1 and 1:1. Coated articles, which are rigid or flexible and elastomeric, and free-standing films and membranes, which are flexible and elastomeric, are produced using the barrier coating mixtures.

Nanocompósitos de argila e polímero

Aplicação: barreiras de permeação de gases (InMat e Michelin)

Precedente: TOYOTA (poliamida)

Como se faz

- A argila tratada com um sal de **amônio quaternário**
- Resulta argila **organofílica**
- Argila organofílica é misturada ao polímero em extrusora
- Nos casos de sucesso, a argila se dispersa no polímero na forma de **lamelas com espessura nanométrica**

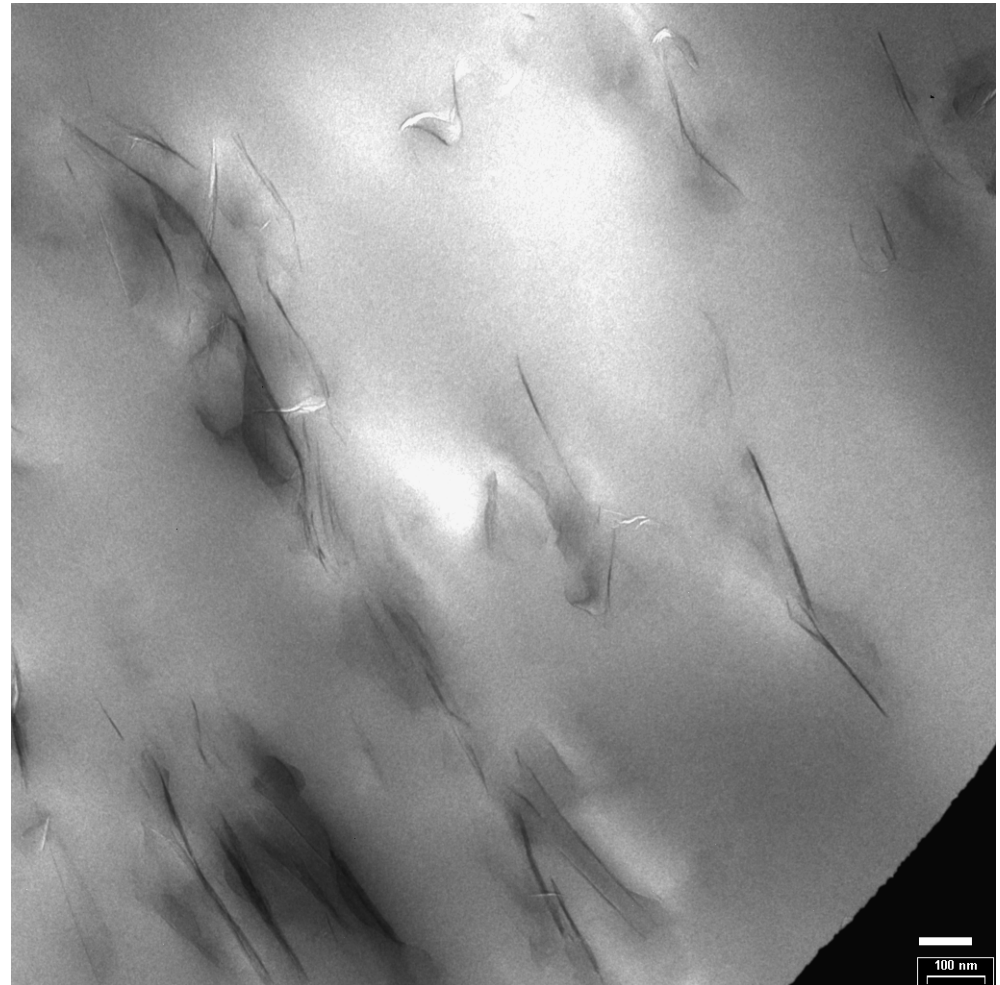
Quem patenteia, no mundo?

- Número de patentes depositadas com as palavras-chaves “nanocomposite(s) AND clay(s)”: 216 patentes concedidas e 76 requeridas, total de 292 patentes*
- Número de patentes recuperadas com a palavra-chave “nanocomposite(s)”: 807 concedidas e 347 requeridas, total de 1154 patentes.*
- As dez empresas que mais patentearam em nanocompósitos poliméricos: Eastman Kodak, AMCOL International, Eastman Chemical, Dow Chemical, BASF, Bekaert, Sumimoto Special Metals, Rohm and Haas, Exxonmobil Chemical Patents e Matsushita Electric.
- Entre as instituições de pesquisa que depositaram patentes constam: University of South Carolina Research Foundation, Korea Advanced Institute of Science and Technology (KAIST), Industrial Technology Research Institute de Taiwan, University of Chicago, University of Massachusetts, Cornell Research Foundation, Kawamura Institute of Chemical Research e MIT (Massachusetts Institute of Technology).

* Informações obtidas no site da Thompson Delphion™ <https://www.delphion.com/cgi-bin/patsearch> período 1997-2004.

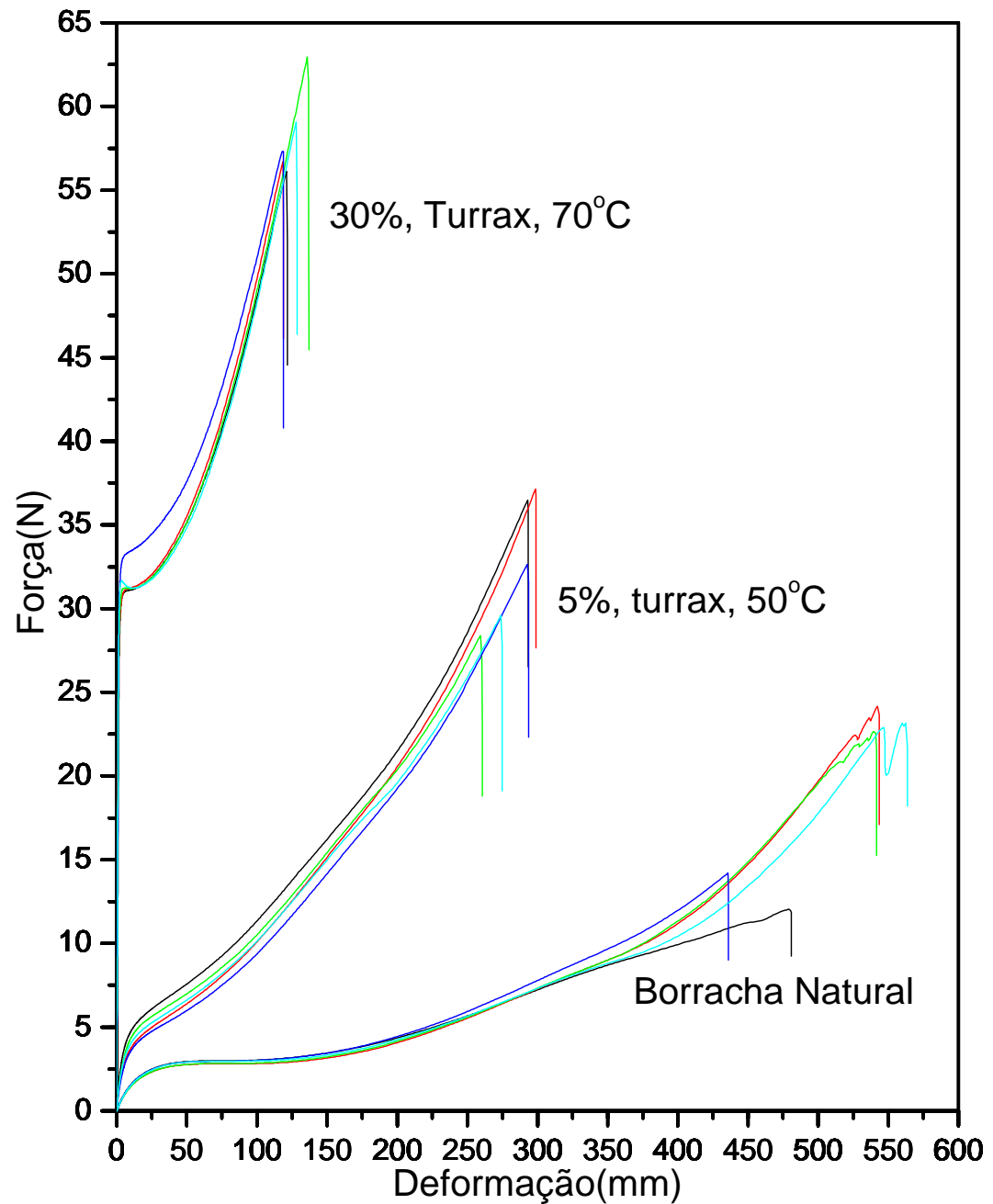
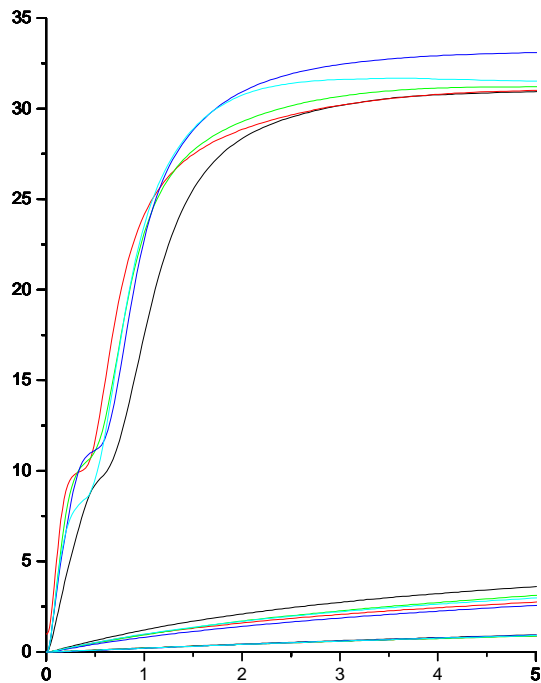
Novidade: nanocompósitos de látex

- **Água** é o melhor esfoliante conhecido, de argila
- **Água** é o dispersante de látexes
- Látex + argila em água
- Depois de seco: nanocompósito

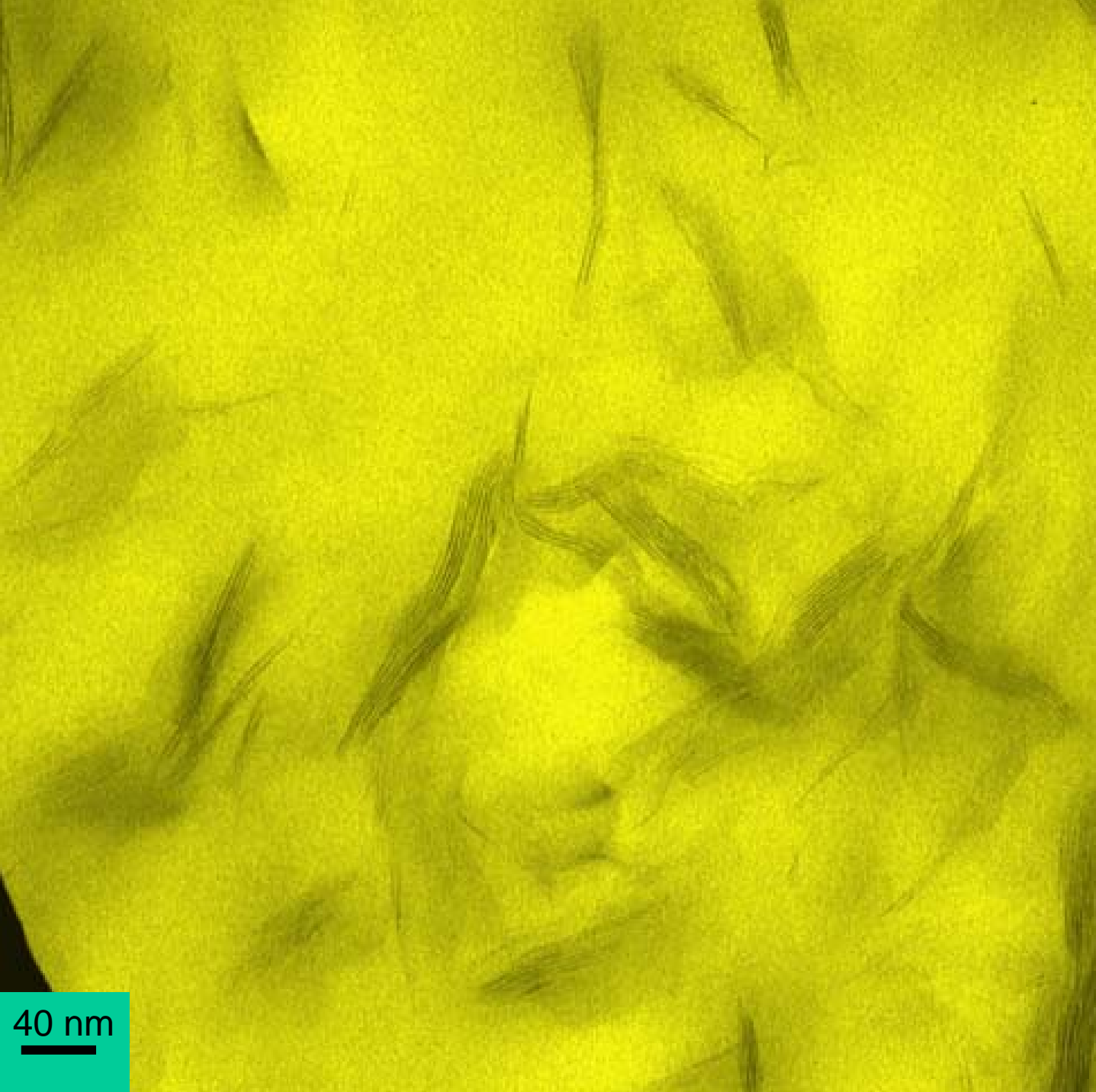


100 nm

Propriedades mecânicas inéditas



Nanocompósito polímero-argila



40 nm

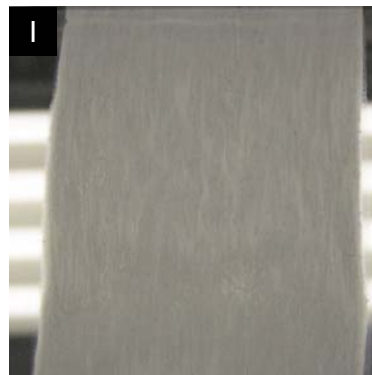
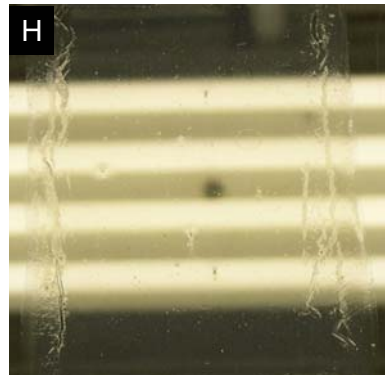
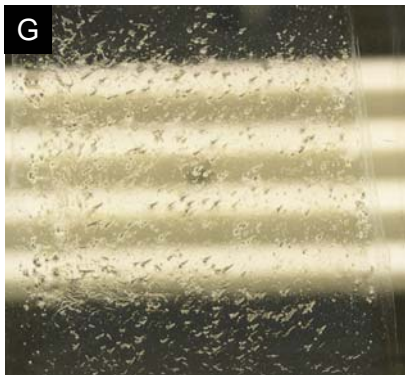
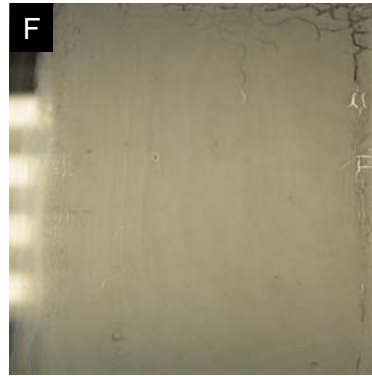
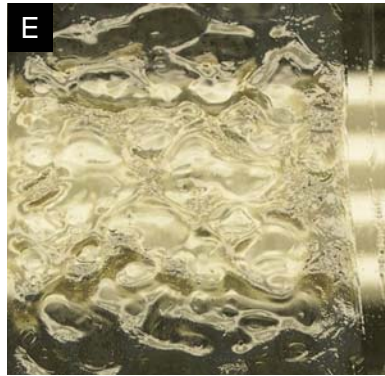
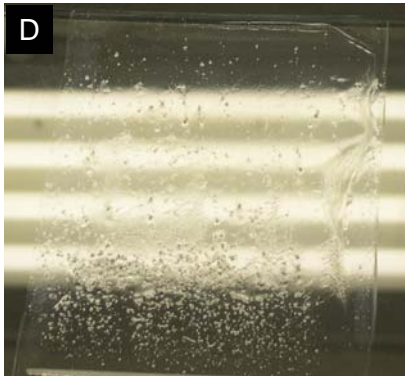
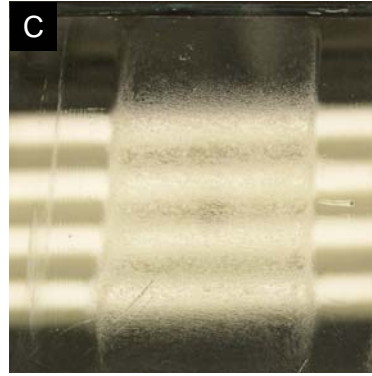
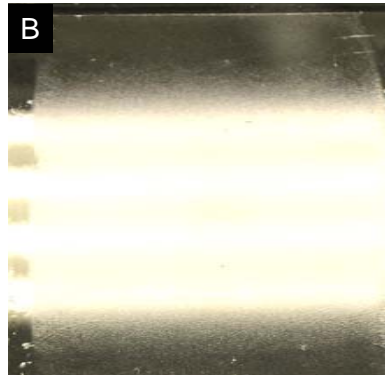
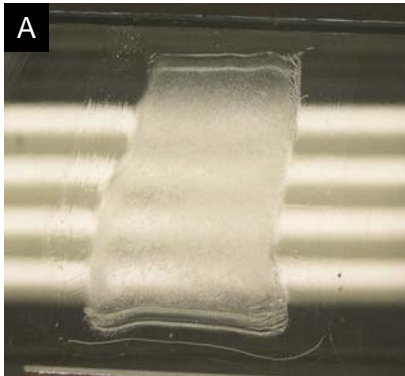
Um atrativo

- É possível mudar drasticamente as propriedades mecânicas de um polímero, SEM alterá-lo quimicamente.



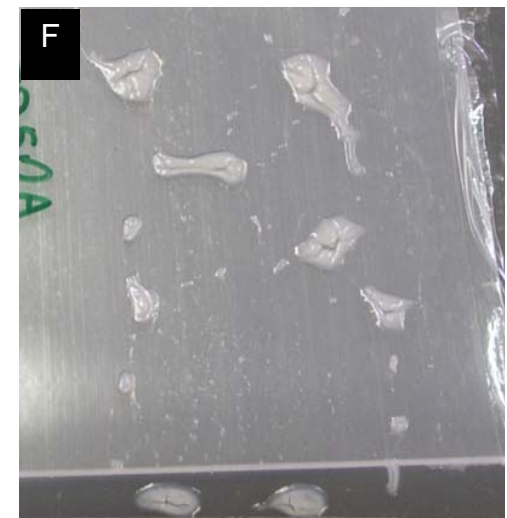
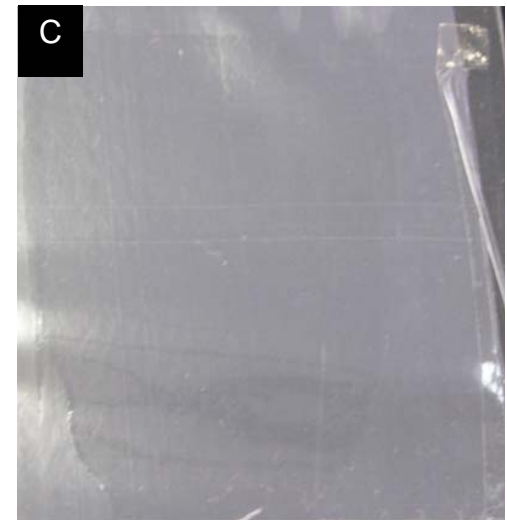
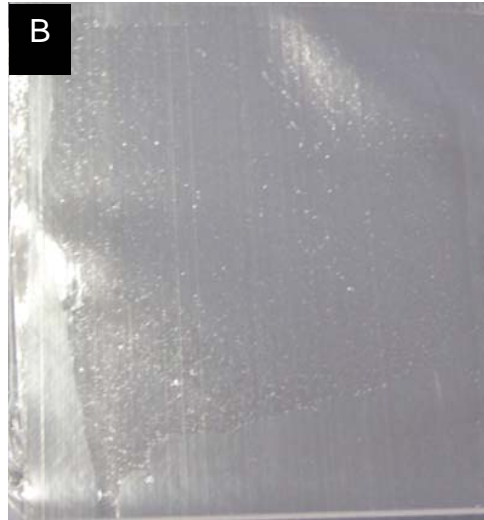
Sem argila:
um péssimo
filme

Com argila: um
filme excelente
e aderente



A range of
film-
forming
properties

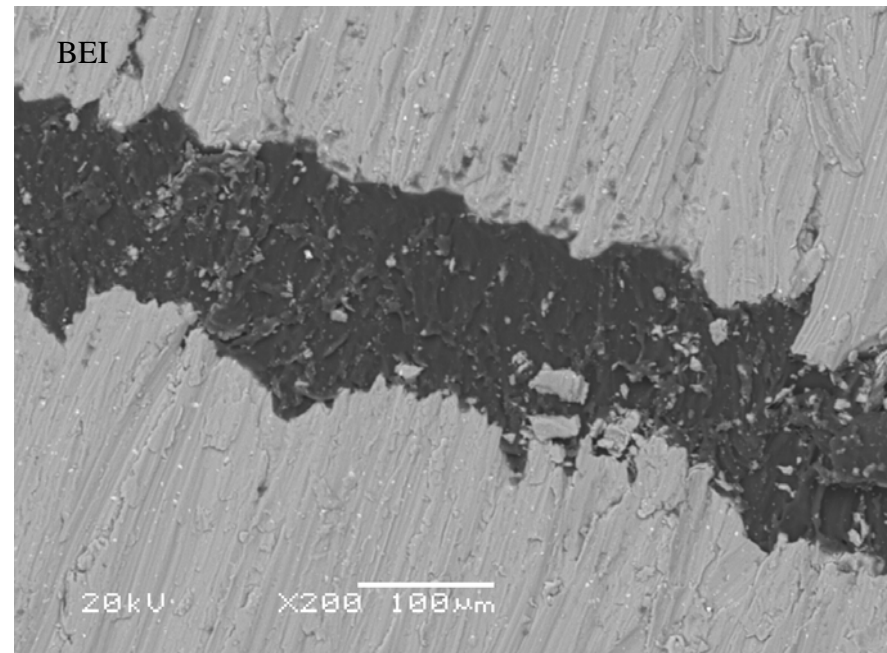
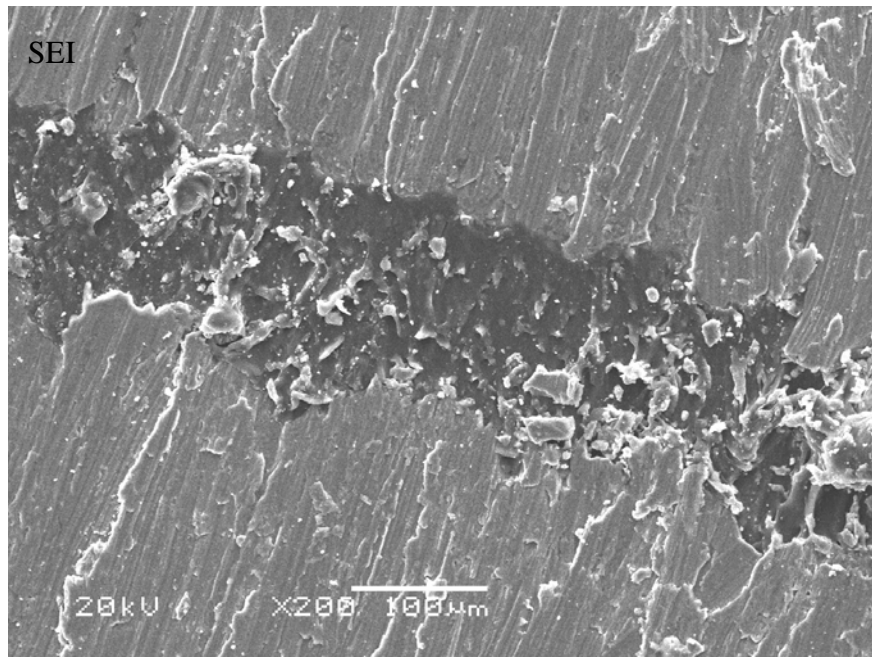
Adhesion to polyethylene





Adesão de chapas de
alumínio,
sem qualquer tratamento

Microscopia da parte central da junta adesiva



Apoio e parcerias

- Capes
- CNPq
- Fapesp
- Finep
- PADCT
- Bunge Fertilizantes
- Carol Química
- Indústria Química Taubaté S/A
- CTMESP/Radicci Fibras
- Orbys
- Oxitenó
- Rhodia-Ster (Mossi & Ghisolfi)

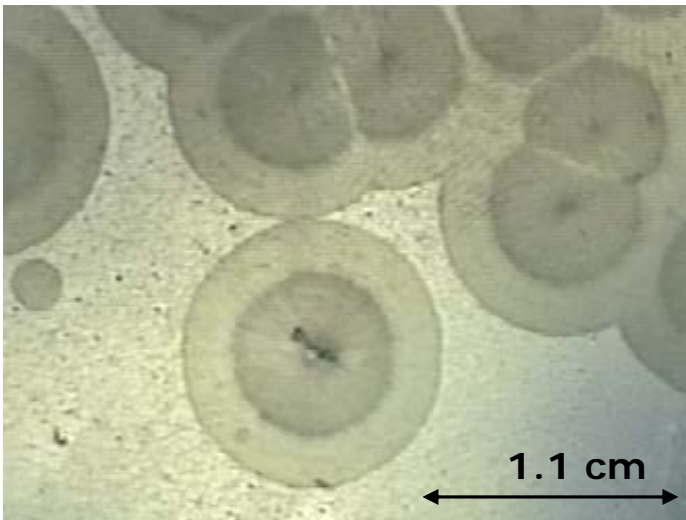


- Esta é uma contribuição do Instituto do Milênio de Materiais Complexos.
- Nossos produtos estão expostos nos estandes da Unicamp e da Orbys.

• *“Já sabemos copiar quase qualquer produto existente, mas o que realmente produz resultados compensadores é **inovar**”*

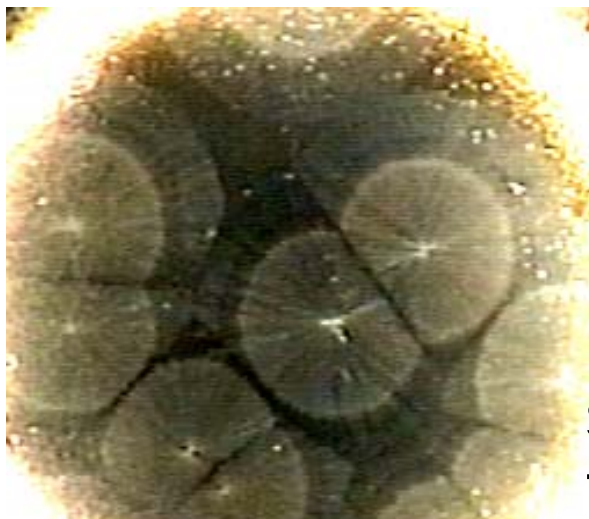
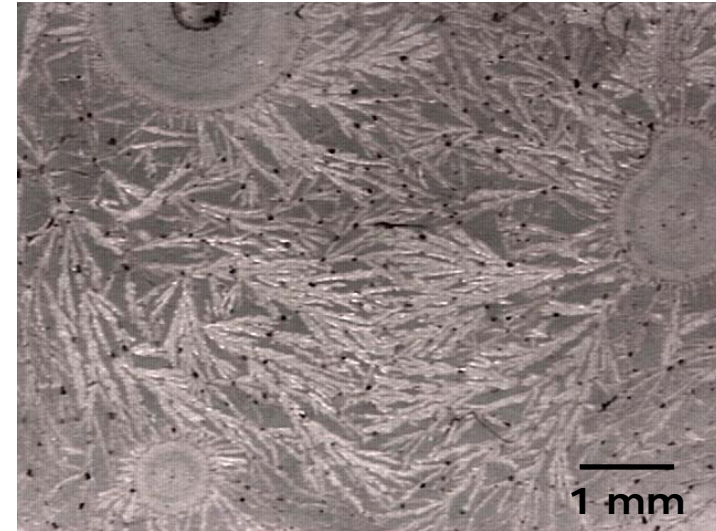
Carmine Taralli, em 1990

Nanocompósito Borracha Natural/Tripolifosfato: mudanças lentas de morfologia



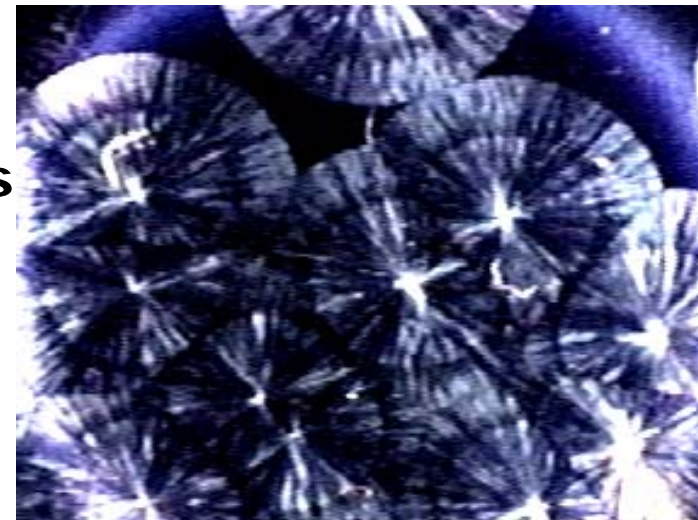
**Visto sob luz
refletida**

**Diferença na
cristalização
depende da
temperatura
ambiente**



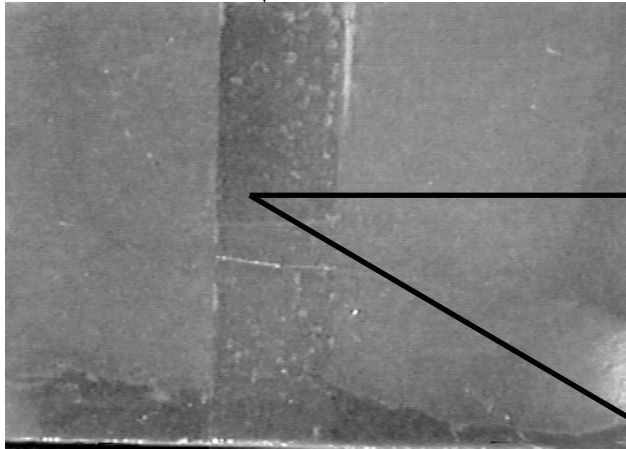
**Entre
polarizadores
cruzados**

**Sob luz
transmitida**



Modificação do Látex de Borracha Natural pela Adição de Polifosfato de Sódio*

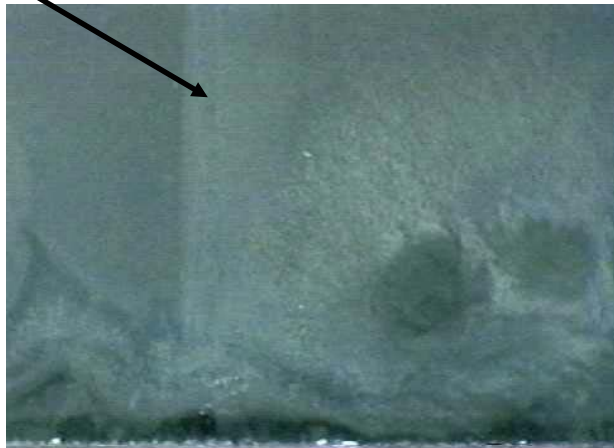
Fita adesiva-área coberta



Filme de látex
**após primeiro
despelamento:**
a borracha é
totalmente
despelada.

Filme com fita adesiva

**Teste de
despelamento
com fita**



Filme de látex
modificado com
polifosfato
**após terceiro
despelamento:**
a borracha não é
danificada