

Water Adsorption, Solvation, and Deliquescence of Potassium Bromide Thin Films on SiO₂ Studied by Ambient-Pressure X-ray Photoelectron Spectroscopy

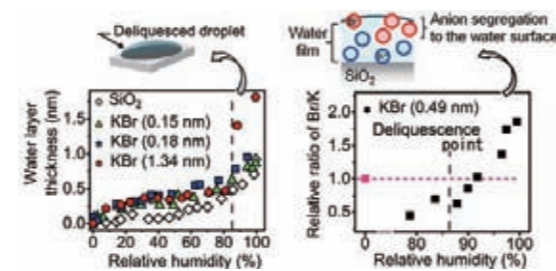
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The Journal of Physical Chemistry C, **114**, 14900-14906 (2010)

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Researchers have paid attention to reactions at the air/water interface because of relevance to atmospheric chemical processes. In this study, the adsorption of water on alkali halide (KBr) thin films evaporated onto SiO₂ was investigated as a function of relative humidity by ambient-pressure X-ray photoelectron spectroscopy with synchrotron-radiated light. Above the deliquescence point (85% RH), the thickness of the water layer continues to increase and reaches more than three lay-

ers near saturation. The enhancement of the Br/K ratio at this stage is roughly a factor of 2.3 on a 0.5 nm KBr film, indicating a strong preferential segregation of Br ions to the air-liquid interface of the thin saline solution on SiO₂.

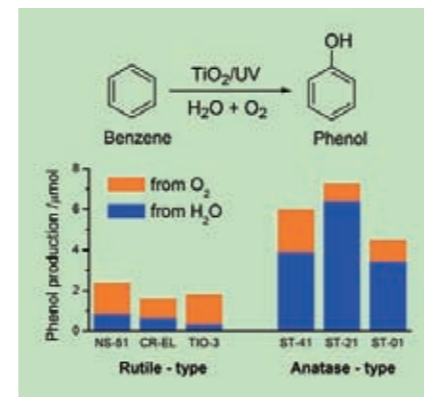


Determination of Oxygen Sources for Oxidation of Benzene on TiO₂ Photocatalysts in Aqueous Solutions Containing Molecular Oxygen

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Journal of the American Chemical Society, **132**, 8453-8458 (2010)

Decomposition of harmful aromatic compounds such as benzene in water by photocatalytic reactions on TiO₂ particles is a useful means for treatment of polluted water. When benzene is photocatalytically oxidized, phenol is produced as a main intermediate. We found that both water and O₂ are the sources of oxygen introduced into phenol. Using anatase-type TiO₂ powders, which showed high activity for oxidation of benzene, 70-90% of oxygen introduced into phenol was from water, whereas the contribution was small using rutile-type TiO₂ powders. The high photocatalytic activity of anatase-type powders is attributed to the efficient conversion of benzene to phenol using water as the oxygen source.



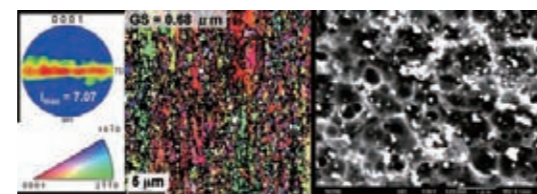
Application of Rapid Solidification Powder Metallurgy to the Fabrication of High-strength, High-ductility Mg-Al-Zn-Ca-La Alloy through Hot Extrusion

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Acta Materialia, **59**, 273-282 (2011)

Rapid solidified Mg-Al-Zn-Ca-La alloy powders were consolidated by SPS and extrusion under small thermal history to control grain growth and coarse precipitates. The tensile strength up to 420 MPa was promising for the improvement in their mechanical properties, especially with maintaining an elongation value of 20%.

This superior balance was due to both refined α -Mg grains less than 1 micron and fine Al-La precipitates with 300-500 nm. 1.5 mass% La content lead to higher mechanical properties compared to those of 3.3 mass% as a result of the better balance between grain refinement and precipitated compounds formation.



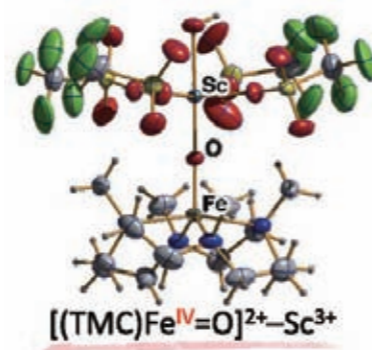
Crystal Structure of a Metal Ion-Bound Oxoiron(IV) Complex and Implications for Biological Electron Transfer

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Nature Chemistry, **2**, 756-759 (2010)

Critical biological electron-transfer processes involving high-valent oxometal chemistry occur widely. Photosystem II involves Ca²⁺ as well as high-valent oxomanganese cluster species. However, there is no example of an interaction between metal ions and high-valent oxometal complexes. Here, we report a crystal structure with the binding of the redox-inactive metal ions Ca²⁺ and Sc³⁺ to a non-haem oxoiron(IV) complex, [(TMC)Fe^{IV}(O)]²⁺ (TMC = 1,4,8,11-tetramethyl-1,4,8,11-tetraazacyclotetradecane). This interaction facilitates a two-electron reduction by ferrocene, whereas only a one-electron reduction process occurs without the metal ions. This control of redox behaviour suggests a possible key

role that an auxiliary Lewis acid metal ion could play in nature, as in photosystem II.

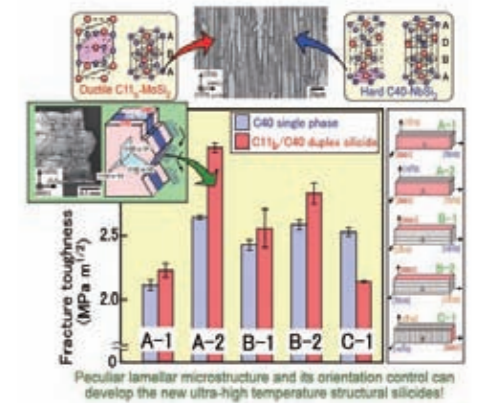


Fracture Behavior and Toughness of NbSi₂-based Single Crystals and MoSi₂(C11_b)/NbSi₂(C40) Duplex Crystals with a Single Set of Lamellae

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Acta Materialia, **59**, 4168-4176 (2011)

This paper reports the development of the MoSi₂/NbSi₂ duplex silicide crystal, which is the new ultra high-temperature structural material designed to use over 1400 °C. We proved that the improvement of the room temperature fracture toughness, that is the bottleneck for practical application of the silicide, can be achieved by developing the peculiar oriented lamellar structure in the C40-phase single crystal. The controlling factors of the fracture mechanism in the duplex crystal were clarified, and the strategy that enables the further improvement of fracture toughness is discussed by focusing on the cooperative control of the lamellar microstructure and crystal orientation.

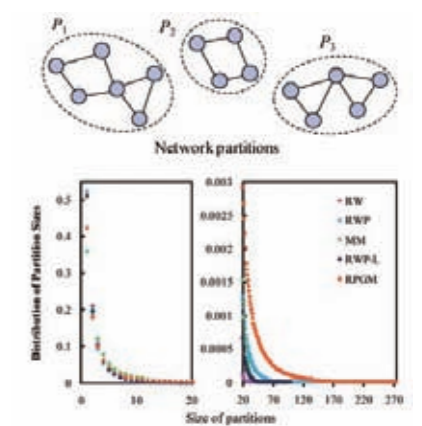


Quantifying Impact of Mobility on Data Availability in Mobile Ad Hoc Networks

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IEEE Transactions on Mobile Computing, **9**(2), 241-268 (2010)

In mobile ad hoc networks, there are many applications in which mobile users share information, e.g., collaborative rescue operations at a disaster site and exchange of word-of-mouth information in a shopping mall. For such applications, improving data availability is a significant issue. In this paper, we propose seven metrics to quantify the influence of users' mobility on data availability. We also report results of experiments that measure the proposed metrics assuming five typical mobility models: RW, RWP, MM, RPGM, and RWP-L. From the results, we can confirm that the proposed metrics are greatly affected by both the mobility model and system characteristics.

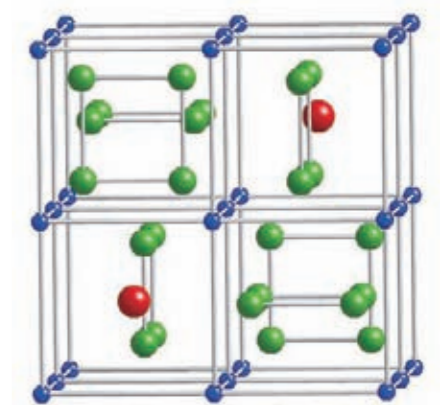


High-Temperature Thermoelectric Properties of Thallium-Filled Skutterudites

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Applied Physics Letters, **96**, 202107-1-202107-3 (2010)

Thermoelectric (TE) energy is utilized in power-generation devices that are designed to convert waste heat into electrical energy. Here, we show a new high-efficiency TE material: Tl-filled skutterudites Tl_xCo₄Sb₁₂. This material shows n-type semiconductor characteristics. By filling Tl into CoSb₃, the TE properties can be tuned. Tl_{0.25}Co₄Sb₁₂ exhibits the best TE performance; the maximum value for the dimensionless figure of merit ZT is 0.90 at 600 K.



Nanocapsules Incorporating IgG Fc-binding Domain Derived from Staphylococcus aureus Protein A for Displaying IgGs on Immunosensor Chips

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(Institute of Scientific and Industrial Research)

Biomaterials, **32**, 1455-1464 (2011)

▲Reprinted from *Biomaterials*, 32, Masumi Iijima et al., Nanocapsules incorporating IgG Fc-binding domain derived from *Staphylococcus aureus* protein A for displaying IgGs on immunosensor chips, 1455-1464, Copyright(2011), with permission from Elsevier.

To enhance the sensitivities and antigen-binding capacities of immunosensors, oriented immobilization of antibodies on the surface of the sensor chip is critical, but to date, this has not been adequately achieved. We developed a way of adsorbing immunoglobulin (Ig) proteins onto bio-nanocapsules (BNCs) through IgG Fc-binding domains derived from *Staphylococcus aureus* protein A (ZZ-BNC). This arrangement permitted 60 molecules of IgG bind to ZZ-BNC and all the IgG Fv regions

to be displayed outwardly for the effective binding of antigens. The BNC-coated sensor chip is very stable and should prove useful for various immunosensor applications due to oriented immobilization of antibodies.

