McGill

Special Mechanical Engineering Seminar

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Organically linked supercrystal of iron oxide nanoparticles with excellent mechanical strength and hardness

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Abstract: It is commonly accepted that the combination of nanosize and elongated mineral constituents in biological materials is the main reason for their exceptional mechanical properties as compared to their rather weak mineral and organic constituents. Here we show that the self-assembly of spherical iron oxide nanoparticles in supercrystals linked together by a thermally induced coupling reaction of oleic acid molecules leads to a nanocomposite with exceptional microbar bending modulus of 114 GPa and strength of up to 630 MPa, respectively. Because the used nanoparticles are spherical, the shear load transfer mechanism for elongated particles is not responsible for the high strength. Instead, it is the covalent backbone of the linked organic molecules, which dominates the mechanical properties, leading to a very high nanohardness of up to 4 GPa.

Biography: Gerold A. Schneider, Full Professor, Hamburg University of Technology (TUHH) is the Head of the Institute of Advanced Ceramics. He is the coordinator of the TUHH – Research Centre "Product Oriented Materials Development", the Hamburg centre of excellence "Integrated Materials Systems" and the collaborative research centre "Tailor-Made Multi-Scale Materials Systems – M3". He has extensive experience in mechanical and fracture mechanical properties of structural as well as electro-ceramic materials where he has organized several workshops and symposia. He has published more than 150 articles and chapters dealing with the fracture of brittle materials (structural ceramics, ferroelectric ceramics and piezoelectric actuators as well as teeth) and the development of lead free ferroelectric ceramics. He is also expert in the field of nanoindentation and piezoresponse force microscopy, which he applied and developed further to be used for ferroelectric ceramics and teeth. He holds two German patents and developed a commercial mechanical testing device together with the company Exact (Hamburg). Dr. Schneider was awarded with the Heinz-Maier-Leibnitz-prize of the German Research Foundation and the German Federal Minister of Education and Science in 1992 and is an academician of the World Academy of Ceramics. In 2009 he was awarded with the Sir Thomas Kay Sidey Visiting Professorship of the University of Otago, New Zealand.