Unlocking Nature's nano-engineering potential

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Abstract:

Nature's supreme dexterity in hierarchical structuring manifests itself in the remarkable complexity of higher organisms that arises from cell differentiation. But even some of the simplest organisms present in abundance at the Earth surface demonstrate tremendous ability to create intricate nanostructures, including using hard and stiff materials, such as silica and calcium carbonate. As a case in point, we consider unicellular green algae, diatoms. These CO2 capturing, photosynthesizing organisms produce around a quarter of oxygen contributed to the atmosphere by this mechanism, and generate a quarter of all biomass on the planet. A key feature of diatom algae is the nanostructured exoskeleton, known as frustule, that is made from amorphous hydrated silica. I shall overview some key aspects of this Nature's nano-fabrication facility, and touch upon their significance in the context of different disciplines, from mineralogy to electronics.

Biography:

Alexander M. Korsunsky is a specialist in the engineering microscopy of materials and structures for optimisation of design, durability and performance. He has made numerous contributions to science in the areas of materials mechanics, microscopy, residual stress evaluation and modelling, eigenstrain theory and structural integrity. He founded the Multi-Beam Laboratory for Engineering Microscopy (MBLEM) in the University of Oxford, Department of Engineering Science, and Centre for In situ Processing Studies (CIPS) in the Research Complex at Harwell. His research group pursues studies of a wide range of natural and engineered materials, from flax fibres, seashell nacre and human dental tissues to zirconia ceramics and porcelain veneers, advanced aerospace alloys, films and coatings, and materials for energy.

Publication of speakers:

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3. Uzun, Fatih & Korsunsky, Alexander. (2020). The Use of Surface Topography for the Identification of Discontinuous Displacements Due to Cracks. Metals. 10. 1037. 10.3390/met10081037.
4. Lunt, Alexander & Korsunsky, Alexander. (2020). Eigenstrain boundary layer modelling of the yttria-partially stabilised zirconia–porcelain interface in dental prostheses. International Journal of Engineering Science. 153. 103315. 10.1016/j.ijengsci.2020.103315.
5. Uzun, Fatih & Korsunsky, Alexander. (2020). The use of eigenstrain theory and fuzzy techniques for intelligent modeling of residual stress and creep relaxation in welded superalloys. Materials Today: Proceedings. 10.1016/j.matpr.2020.04.910.

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