Self-organizing matter for functional materials

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Résumé/Abstract

Shaping, sculpting, and forging customizable compounds into arbitrary forms has the potential to revolutionize technologies for advanced functional materials. Current self-assembly strategies allow for impressive levels of control over either shape or chemical composition, but not both, as self-assembly inherently entangles shape and composition. Inspired by natural and biologically controlled mineralization processes, we here achieve independent control over shape and composition by performing chemical conversion reactions on nanocrystals which were first self-assembled in nanocomposites with programmable microscopic shapes. We show that these conversion reactions are surprisingly materials agnostic, allowing a large diversity of chemical pathways, and develop conversion pathways yielding a wide selection of shape-controlled compositions ranging from perovskites to transition metal chalcogenides. Finally, we introduce new strategies to control the self-assembly of the initial composite shapes using light, to direct the assembly process following exact user-defined patterns. Previously unimaginable customization of shape and composition is now achievable for assembling advanced functional components using bioinspired mineralization strategies.

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Bio

Dr. Wim Noorduin is a scientific group leader at the Dutch scientific institute AMOLF and professor at the University of Amsterdam. Noorduin's research focuses on the dynamic interplay between chemical reactions and crystallisation phenomena to control the emergence of complexity in the solid state.

In 2010, Noorduin received his PhD from Radboud University. From 2010 to 2013, he was at Harvard University as a postdoctoral researcher. From 2014 to 2015, he functioned as both a research associate at Harvard University and an assistant professor at Radboud University. From 2015 onwards, he has been leader of the Self-Organising Matter group at the NWO-Institute AMOLF in Amsterdam.

His papers have been published in a wide variety of prominent scientific journals, and he is the recipient of a various prestigious grants, including Veni, Vidi and KLEIN grants from the Netherlands Organization for Scientific Research.

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