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Engineering Microbial-Induced Carbonate Precipitation via Meso-Scale Simulations

Irina Dana Ofiteru, Enrico Masoero, Denis Taniguchi, Susanne Gebhard, Iulia Mihai, Tony Jefferson, Kevin Paine

The engineering of bacterial activity for material production is subject of increasing interest from the scientific community. An important example is controlling microbially induced calcium carbonate precipitation to repair cracks in concrete. For example, by combining experimental research with macroscale modelling, the Resilient Materials for life (RM4L) project has identified a wide array of bacterial strand that can induce biomineralization in concrete. However, there is a range of scale between the micrometre and the millimetre, where the self-organisation of minerals and bacterial activities during biomineralization is not understood. Insights into the processes taking place at those length scales could provide new tools to select the most promising bacterial strands, better targeting future experimental efforts and thus reducing deployment time and cost for the new technology. This contribution will outline a new approach combine existing expertise from the RM4L network (on characterization of bacterial metabolism and engineering modelling and testing of self-healing concrete) with new mesoscale simulations of bacteria-mineral coevolution at Newcastle University. Key barriers for this undertaking will be addressed, and methodologies and first results from mesoscale modelling will be presented.