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Title: " Watching paint dry: How fundamental science can improve functional coatings"
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Watching paint dry: How fundamental science can improve functional coatings

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The process of paint drying involves the assembly of its different ingredients, in the form of micro and nanoparticles and aggregates in suspension, into a film as the solvent evaporates. The ways in which these particles are assembled will dictate the final architecture of the final coating and therefore its performance. For example, in the case of antibacterial paint, the amount of bactericidal agent that accumulates at the top surface will determine its effectiveness against microorganisms.
We have proven that in drying blends of large and small colloidal particles, small particles can become trapped near the air-water interface as it moves down.[1] This results in a particle concentration gradient from the top to the bottom of the wet film, which drives large particles to diffuse down. As a result, a stratified colloidal film is formed with an enrichment of small particles at the top and most large particles at the bottom (Fig. 1a). In this talk, I will describe how we can harness and tune this size segregation process to tailor the final structure of coatings. I will present case studies for bactericidal[2] and abrasion resistant[3] coatings (Figs. 1b-c), but these concepts are applicable to other functional coatings as well as to a wider range of products based on the drying of particle suspensions such as inks, adhesives, or cosmetics. Time allowing, I will also present some of our recent efforts to harness the fluorescence lifetime of molecular rotors to develop science-based formulation approaches.

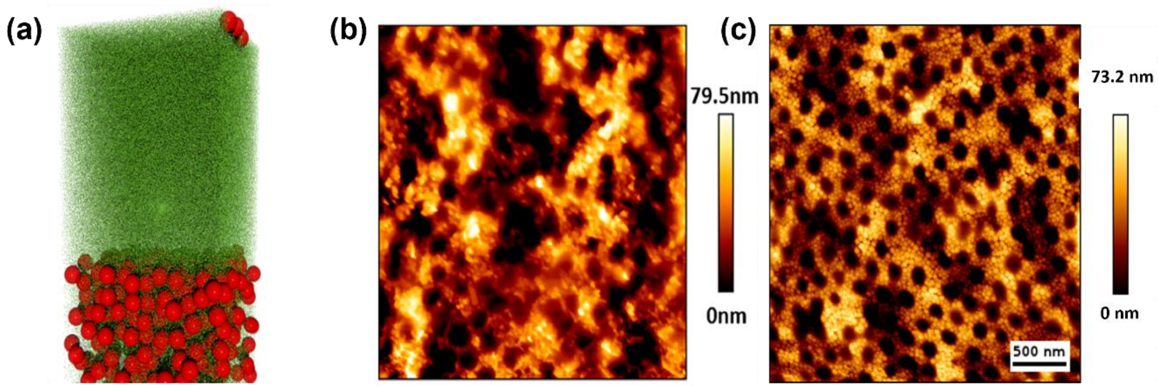

Figure 1. a) Final snapshot of Brownian dynamics simulations of drying blends of small (green) and large (red) colloidal particles. AFM topography maps of the top surface of composite colloidal films which show surface structures made of a) ZnO nanoparticles and b) silica nanoparticles, for antibacterial and abrasion resistant applications, respectively.

References
[1] A. Fortini et al. Phys. Rev. Lett. 2016, 116, 118301.
[1] Y. Dong et al. ACS Appl. Polym. Mater. 2020, 2, 626-635.
[2] J. Tinkler et al. J. Colloid Interface Sci. 2021, 581, 729-740.

Dr Nacho Martin-Fabiani is a UKRI Future Leaders Fellow and Senior Lecturer in Materials Science in the Department of Materials at Loughborough University (UK). He leads a research group working in the fields of colloid, interface, and soft matter science. Current research lines include the development of a new generation of functional coatings - including antibacterial and abrasion resistant surfaces – and experimental and computational methods to aid soft materials formulation. He has received awards and honours for his work, including a Vice-Chancellor’s Research Fellowship at Loughborough University (2016), the Polymer Lecture Exchange Award by the Institute of Physics and the American Physical Society (2019), and a UKRI Future Leaders Fellowship (2020). He sits on the Joint Colloids Group committee from the Royal Society of Chemistry and the Society of Chemical Industry and is Associate editor of Frontiers in Soft Matter.