Contribution ID : **21** Type : **Poster**

Understanding and controlling the formation of photonic crystals from polydisperse colloidal systems

Thursday, 25 November 2021 18:48 (1)

The fundamentals of crystallisation and glass formation are not yet fully understood. Colloidal suspensions have been shown to be promising model systems for understanding these processes. As colloidal motion is Brownian, rather than ballistic, kinetics and dynamics can be studied in real-time. It is well documented that colloidal suspensions can "successfully crystallise" when the particles in the system have sufficiently low polydispersity.[1,2] This means that the particles must have a similar average size and shape. If a system is highly polydisperse, this will hinder the solidification process.

In this work we will explore colloidal nanodiamonds. Nanodiamonds are a topic of interest in many material studies due to their wide variety, and unique mechanical and optical properties.[3,4] Detonation nanodiamonds (DNDs) are of particular interest due to their unique fabrication process. Due the detonation synthesis method, the particles are small (several nm) and faceted, but in solution self-assemble into highly irregular fractal shapes.[5] Despite this high polydispersity, when centrifuged, these types of DNDs can yield incredibly ordered structures and form iridescent photonic crystals – this is highly surprising given the highly irregular structures of these materials. These photonic crystals were first discovered by Grichko et al.,[5] however, the mechanisms behind these highly ordered structures are still unknown. With a combination of lab techniques and beam time allocations at the Australian Synchrotron, ANSTO and potentially overseas neutron facilities, we will systematically investigate these nanodiamond photonic crystals, and examine their structure and formation kinetics.

Level of Expertise

Student

Presenter Gender

Woman

Pronouns

She/Her

Which facility did you use for your research

Australian Synchrotron

Students Only - Are you interested in AINSE student funding

Yes

Do you wish to take part in the Student Poster Slam

No

Condition of submission

Yes

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Session Classification : Poster Session

Track Classification : Physics, Surface & Condensed Matter