Summary

The aim of the project undertaken deals with forming TiB_2 nanorods in liquid-phase medium. To facilitate the means of production of nanorods, we use surfactants. Thus, it becomes crucial to know the perfect surfactant and its respective concentration, for the nanorod synthesis.

Surfactants are classified based on their ionic character into cationic, anionic and non-ionic. Most of the surfactants popular are amphiphile carrying both ionic and non-ionic sides. The role of surfactant is to create electrical multipole around the nanomaterial. Thus, the nanomaterial looks like it takes a net charge. Due to the net charge, there exist electrostatic repulsions which forbid aggregation of nanomaterial. Some of the best-known surfactants are CTAB, Sodium Cholate, Sodium Dodecyl Sulphate (SDS).

It becomes essential to understand how these surfactants affect the synthesis of nanorods. Surfactants are rated based on their dispersity. Compared to nanosheets, nanotubes require higher dispersity, the hence higher concentration of surfactant, to yield more substantial amounts of nanotubes. But these concentrations vary according to the structure of surfactant.

In general speculation, we expect that to obtain more amounts of nanomaterial, it is required to increase the concentration of surfactant. The thinking holds good till specific critical concentration of surfactant, beyond which the production of nanomaterial decreases. The probable reason for the decrease is that the nanomaterial gets destabilized due to electrostatic screening at high surfactant concentration. Thus, it becomes essential to analyze how nanomaterial depends on the surfactant's structure and strength. But at a lower concentration of surfactant, type and size of surfactant don't affect the nanomaterial outcome.

Nanomaterials which are coated by surfactants remain stabilized because of electrostatic repulsion from other molecules. Experiments state that electrostatically the nanomaterial remains stabilized even at a lower concentration of surfactant. Dimension and electric potentials of the nanomaterial are not affected by changing the concentration of surfactant. So, the quality is intact, but the quantity is varied.

Like surfactant's concentration, choice of surfactant also plays a vital role in nanomaterial production. Though the choice of surfactant does not affect the process of synthesis, it does affect the stabilization of nanomaterial in the solution because stabilization is related to the dispersion effects and the size of the surfactant.

To conclude, surfactants behave similarly in the synthesis of nanomaterial, thus choice of surfactant is less important, compared to the cost and environmental effects. Amount of surfactant needs to be monitored to implement good results.

Reference:

Griffin, Aideen; Nisi, Katharina; Pepper, Joshua; Harvey, Andrew; Szydłowska, Beata M.; Coleman, Jonathan N.; et al. (2020): Effect of Surfactant Choice and Concentration on the Dimensions and Yield of Liquid-Phase-Exfoliated Nanosheets. ACS Publications. Journal contribution. https://doi.org/10.1021/acs.chemmater.9b04684.s001