Characterization of nanoparticle size and distribution in biological environments and understanding the parameters that affect them are imperative to accurately assess nanoparticle toxicity. In the case of in vitro studies, nanoparticles must be well-dispersed to ensure uniform dosing. Similarly, for in vivo studies, delivering nanoparticles in a well-dispersed form is necessary for accurate assessment of their toxicity. Based on these considerations, the goal of this investigation is to accurately evaluate the TiO₂ nanoparticle dispersion in different cell culture media using the high throughput Dynamic Light Scattering DynaPro™ Plate Reader. To improve the dispersion of these nanoparticles, dispersing agents such as bovine serum albumin (BSA) and fetal bovine serum (FBS) were explored.

The concentrations for TiO₂, BSA, and FBS were 50 µg/mL, 2 mg/mL, and 0.5-5 wt.%, respectively. All measurements were conducted in a 384-well plate at room temperature. To ensure reproducibility, samples were loaded in triplicate and five runs were collected for each well.

The spectral view (Figure 1) suggests BSA (2 mg/mL) as an effective dispersing agent in all media but LB and TSB. By contrast, 5 wt.% FBS (equivalent to 2 mg/mL BSA) resulted in highly dispersed TiO₂ in all media. No noticeable change in nanoparticle dispersion was observed with FBS concentration decreased to 1 wt.% (Figure 1), which implies FBS as an effective dispersing agent. In addition to the qualitative analysis, particle size distribution was also calculated using the built-in regularization algorithm.

Figure 2 shows an example of TiO₂ particle size distribution in LB, which again confirmed the effectiveness of FBS.

Overall, this study demonstrated the use of the DynaPro™ as a convenient and effective tool for determining TiO₂ nanoparticle size and for evaluating the effects of different dispersing agents much faster than conventional “batch” DLS would have allowed. Currently, more effort is being made to understand the dispersion mechanisms. Kinetic/stability study of TiO₂ suspensions is also being performed.

This note graciously submitted by Zhaoxia Ji¹ and Jeffrey I. Zink¹ ²
¹ UC Center for Environmental Implications of Nanotechnology, University of California, Los Angeles, California, 90095, USA.
² Department of Chemistry and Biochemistry, University of California, Los Angeles, California, 90095, USA.