Characterization of TiO_2 Nanoparticle Dispersion in Cell Culture Media Using High-Throughput Dynamic Light Scattering

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 TiO_2 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 TiO_2, 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 TiO_2 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 TiO_2 particle size distribution in LB, which again confirmed the effectives of FBS.

Overall, this study demonstrated the use of the DynaPro™ as a convenient and effective tool for determining TiO_2 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 TiO_2 suspensions is also being performed.

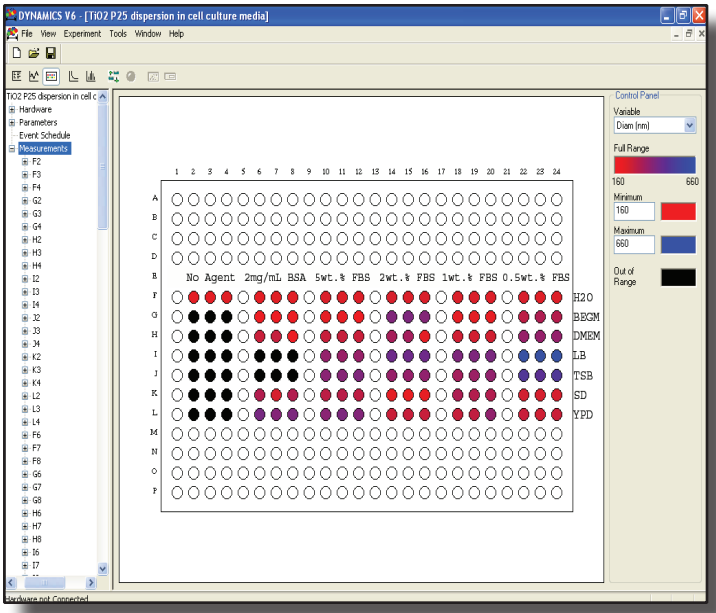

Figure 1. Spectra view of TiO_2 nanoparticle dispersion in water and six different cell culture media (BEGM, DMEM, LB, TSB, SD, and YPD) suggests severe agglomeration in all media without dispersing agents, improved dispersion in most media using 2 mg/mL BSA, and the best dispersion using ≥1 wt.% FBS.

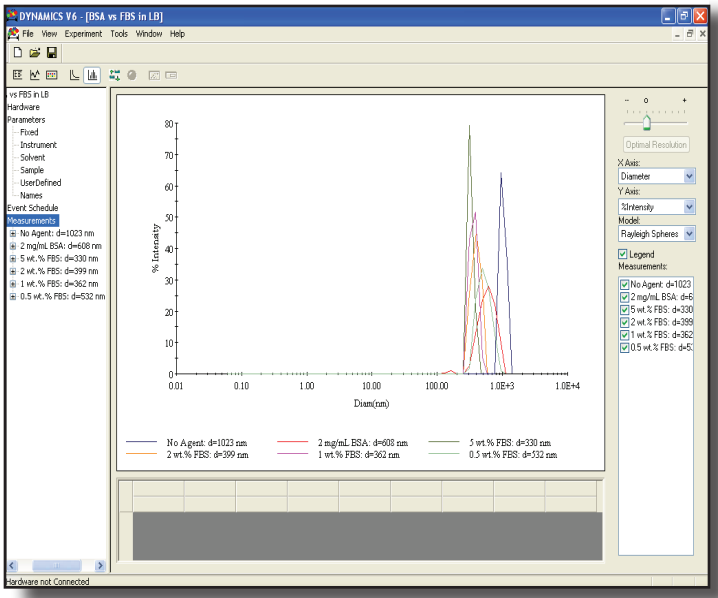

Figure 2. TiO_2 particle size distribution in LB calculated by the built-in regularization algorithm shows the effect of BSA and FBS dispersing agents. The corresponding hydrodynamic diameter (d) of TiO_2 was determined to be 1023 nm, 608 nm, 330 nm, 399 nm, 362 nm, and 532 nm for no dispersing agent, 2 mg/mL BSA, 5 wt.% FBS, 2 wt.% FBS, 1 wt.% FBS, and 0.5 wt.% FBS, respectively

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