Is there an absorptive advantage to using a slurry of Nano Particles (NP’s) vs. thin films?

Consider a reactor in which sun is absorbed by nanoparticles which then drive a reaction. How does light behave in this system? Here experimental data was obtained and compared with literature values* for Hematite(a). The effect of scattering, which is greater in the case of nanoparticulate systems, increases the effective per mass light extinction by allowing additional absorption opportunities from scattered secondary light. This result agrees with theory, which shows that for small particles, the calculated extinction coefficient (b) has a significant contribution from the scattering term, where thin films (and larger particles) are dominated by the absorbance term.

\[ \frac{I}{I_0} = e^{-\alpha z} \]

Where \( I \) is intensity, \( \alpha \) is total extinction coefficient, and \( z \) is depth into a medium. Here the attenuation of light by Hematite is compared on a per mass basis over the range 2.2 eV - 6.2eV with total intensity of available light referenced to the AM1.5 spectrum.

\( a) \) Light attenuation is given by: \( \frac{I}{I_0} = e^{-\alpha z} \)

\( b) \) Extinction coefficient calculation for light in the range \( \lambda=200\text{nm} - 565\text{nm} \), for 40nm diameter, spherical, monodisperse \( \text{Fe}_2\text{O}_3 \) nanoparticles

*J. Appl. Phys., 33, 6, 1962, p2140-2141