Electrophoretic Movement of Quantum Dots

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Our research group is interested in making chemical patterns with a feature size of a few nanometers using quantum dots (Qdots) on a self-assembled monolayer (SAM). In this study, we quantified the electrophoretic mobility of cadmium selenide Qdots in polyacrylamide gels. These Qdots display excellent photocatalytic and photoemission properties arising from the quantum confinement effects. By varying the orientation of the electric field, we plan to electrophoretically move the Qdots as “pens” on a photocatalytically reactive SAM to create complex nanopatterns. Since Qdots are synthesized and stabilized in non-polar organic solvents, surface ligands, such as diethylaminoethanethiol, are used to impart a charge on the surface, making them water-soluble. The effective surface charge, or the zeta potential, of these charged Qdots of two different size ranges was determined using polyacrylamide gel electrophoresis (PAGE). The free solution mobility was found to be $1.9 \times 10^{-4} \pm 0.5$ cm^2/V-s for 3.9 nm Qdots and $2.0 \times 10^{-4} \pm 0.4$ cm^2/V-s for 2.3 nm Qdots. The zeta potential at room temperature was 27 ± 7 mV for 3.9 nm Qdots and 30 ± 6 mV for 2.3 nm Qdots under a 3.75 V/cm field strength and 5 mA current in a pH 7.1 buffer. The magnitude of these zeta potentials is comparable to those reported in literature. Using these data as guidelines, electrophoresis of Qdots preadsorbed on SAMs is currently underway.