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Surface modification of colloidal quantum dots with amino acids and proteins.

M. Jones, S-Y. Ding, Q. Xu, M. Tucker, M.E. Himmel and G. Rumbles

National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO, 80401-3393
U.S.A.

Colloidal, semi-conductor quantum dots, such as prototypical cadmium selenide, CdSe, provide many new opportunities in fields that range from electro-optic devices to labeling of biological systems. By simply changing the size of the quantum dots within the quantum confined regime provides an opportunity to tune the wavelength of both absorption and emission. Although another, adventitious feature is their photochemical robustness. Deploying these materials in electro-optic devices is non-trivial, however, as there is a need to promote the transfer of charges or excitons and in order to improve the efficiency of the process requires close packing of the QDs.

Here, we report our work on the use of natural and genetically-modified, self-assembling proteins as vehicles for assembling QDs into high-order bioconjugate structures, such as molecules, chains and arrays. An integral step in this process is the selective linking of a single protein to the surface of the quantum dot, whilst simultaneously passivating all the remaining surface states, and retaining the self-assembling functionality of the protein. In this context, we report results on the binding of natural and modified amino acids to the surface of a core-shell QD, (CdSe)ZnS. We specifically focus on three natural amino-acids: lysine, cysteine and histidine; as well a number of modified cysteines. We examine the importance of pH on the stability of the colloids as well as the ability for each molecule to passivate the surface states of the QDs. We report both steady-state and time-resolved photoluminescence data from this study.

We will also report results on the use of new, genetically modified proteins to control the separation of colloidal quantum dots, when bound to a crystalline cellulose substrate.