Quantum Dots for α-Voltaics

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There exists a need for small electrical power sources, such as for use in microsystem applications, which can operate unattended for extended periods. The devices need to be durable, inexpensive to produce, and of small size. Devices that are currently available are expensive, fragile, and do not scale well to smaller sizes. A class of devices that meets most of these requirements is the Radioisotope Battery. A Radioisotope Battery employs a radioactive source, a photovoltaic device, and possibly an intermediate phosphor layer. The photovoltaic device converts radiation from the radioactive source into electrical energy. However the photovoltaic device degrades as a result of the radiation. To remedy this, a phosphor layer may be introduced, which will absorb the radiation and emit photons, which are in turn converted by the photovoltaic device into electrical energy. In this case, it is the phosphor layer that degrades as a result of the incident radiation. To address this issue, our research will incorporate a phosphor layer consisting of semiconducting quantum dots. Quantum dots are nanoscale bits of semiconducting material, which due to their size behave quite differently from their bulk counterparts. Where bulk semiconducting material will degrade under alpha radiation, quantum dots have been shown to be extremely radiation resistant, and will fluoresce monochromatically (due to their quantum nature) under alpha bombardment. Because their fluorescence is monochromatic, the photovoltaic device may be tuned to efficiently convert that particular frequency into electrical energy. This presentation will discuss the selection and characterization of radiation sources, quantum dot phosphors, and photovoltaic devices suitable for use in alphavoltaic batteries.