From Synthesis to Solar Cells: Exploring Lead-free NIR-Absorbing Colloidal $AgBiS_2$ Quantum Dots

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Quantum dot solar cells (QDSCs) represent a promising avenue for photovoltaic technologies due to their tunable bandgaps and potentials in solution-processed fabrication. However, most quantum dots (QDs) currently applied in the field of photovoltaics contain toxic heavy-metal elements, such as lead. To this regard, silver bismuth sulfide ($AgBiS_2$) quantum dots have emerged as a lead-free alternative offering new perspectives for more environmentally friendly solar energy applications.

Currently, $AgBiS_2$ QDSCs face a few major challenges. First, the diffusion length of charge carriers is too short, leading to excessive charge recombination and consequently lower photocurrent as the absorber's thickness increases. One approach to address this issue is the application of plasmonic nanocrystals to enhance the light absorption in a very thin $AgBiS_2$ absorber layer (thickness < 40 nm) and thus improving the device performance. Second, the conventional colloidal synthesis method of $AgBiS_2$ QDs involves the use of toxic and malodorous sulfur precursor (i.e. trimethylsilyl compounds (TMS)), which also poses environmental and safety concerns. Therefore, alternative synthesis routes are being explored to mitigate this issue. Third, during the air-storage of $AgBiS_2$ solar cells fabricated in our lab, instability issues were observed. In this poster, I will present my experimental results obtained on the above-mentioned sub-topics.

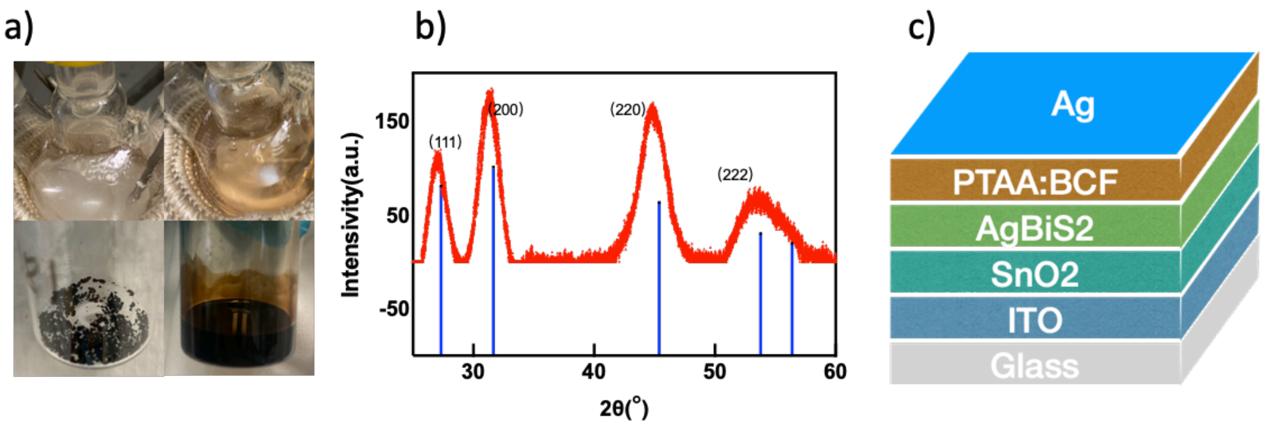

Figure1. a) $AgBiS_2$ Quantum Dots synthesis set-up; b) XRD patterns of $AgBiS_2$ powder. The vertical lines are the bulk reference of $AgBiS_2$ (ICSD, code 01-089-2045); c) Architecture of solar cells based on $AgBiS_2$ Quantum Dots.