Building Forster-based Antenna From Inorganic Perovskite Nanocrystals

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Efficient solar-to-chemical energy conversion is one of the most compelling challenges currently faced by the scientific community. Inspired by the natural photosynthetic mechanisms, realizing an energy conversion devices based on Forster Resonance Energy Transfer (FRET) could provide a potential solution. Thanks to their tunable optical properties, colloidal quantum dots could be ideal candidates to exploit such a concept, if the compositional and structural parameters leading to high efficiency are unveiled.

The recently discovered all-inorganic perovskite nanocrystals (PeNCs) exhibit size-and composition dependent bandgap, large absorption coefficients and very high quantum yields superior to previously studied metal-chalcogenide nanocrystals, particularly in the blue and green region of the visible spectrum.[1,2] Despite their exceptional optical properties, PeNCs suffer from a number of drawbacks that hamper their implementation in FRET-based architectures, such as: photodegradation and fast anion exchange.

In this contribution. we report about the deposition of a low-temperature aluminium oxide(AlOx) atomic layer deposition matrix that protects PeNCs films from air, polar solvents, heat and light, while also enabling the assembly of a multilayered structure with angstromic control over the interlayer distances.[3] We demonstrate with a number of electron microscopy techniques (STEM-HAADF, EELS, EDX) and X-ray photoelectron spectroscopy that AlO_x penetrates and infills the space in-between PeNCs preventing any effects of photo(solar irradiation) and thermal sintering (200 ^oC in O_2). Additionaly, AlO_x forms a capping layer on top of the PeNC film and acts as a physical barrier to slow down humidity and water diffusion in to the film (more than 50 days in air and 1 hour in water). The initial results on the optical properties of the multilayered structures and on the FRET dynamics will be discussed.

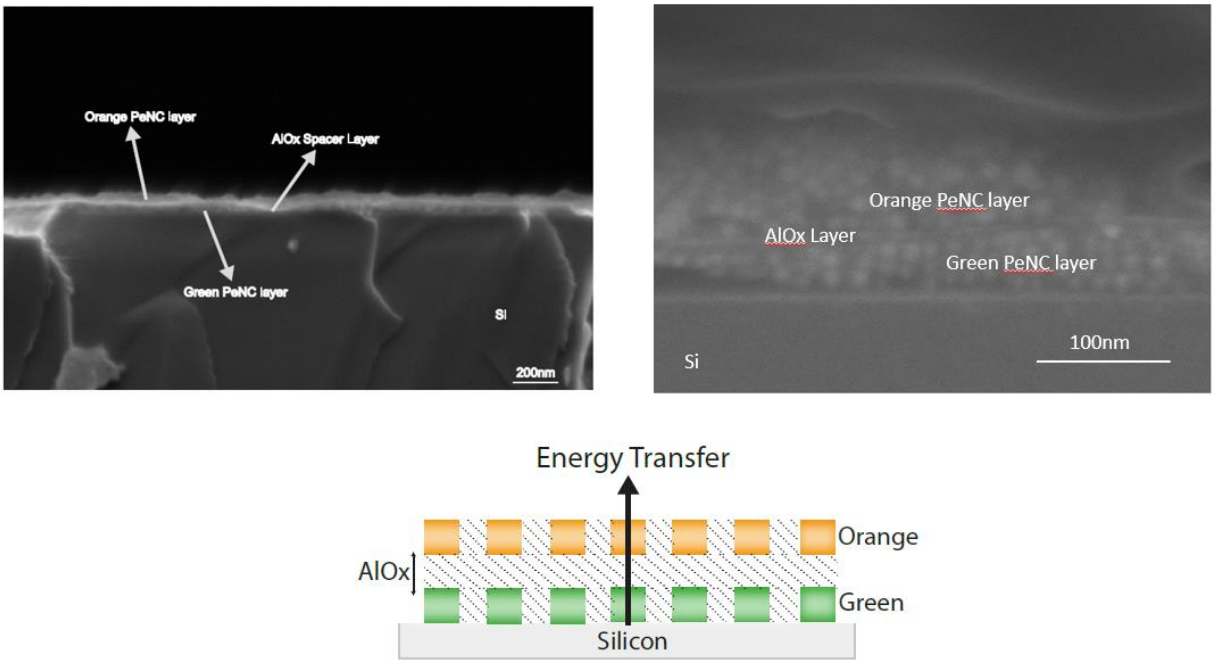

Fig. 1 (Top) Cross-sectional SEM image of a typical bilayered structure with different magnifications (Bottom) Simplified schematic of an infilled bilayer structure

(1) Protesescu, L.; Yakunin, S.; Bodnarchuk, M. I.; Krieg, F.; Caputo, R.; Hendon, C. H.; Yang, R. X.; Walsh, A.; Kovalenko, M. V. *Nano Lett.* **2015**, *15* (6), 3692–3696.
(2) Nedelcu, G.; Protesescu, L.; Yakunin, S.; Bodnarchuk, M. I.; Grotevent, M. J.; Kovalenko, M. V. *Nano Lett.* **2015**, *15* (8), 5635–5640.
(3) Loiudice, A.; Saris, S; Oveisi, E; Alexander, D; Buonsanti, R (submitted)