# Edge anchoring stabilizes perovskite quantum dots via multi-amino ligands

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## Introduction

Perovskite quantum dots (PQDs) suffer from poor stability against ambient stimulus (light, heat, moisture, polar solvent and electric field), which results in degradation of PQDs during solution-based purification and storage processes, and in ionic migration and performance decline in operative electroluminescent light-emitting devices (LEDs). **These stability issues severely limit the commercialization of PQDs and the relevant devices**. The instability of PQDs stems in a large degree from loose binding between the inorganic QD core and their surface ligands.[1] In this work, we reported "**edge anchoring**" PQDs that are stabilized by a new multi-amino chelating ligand named AHDA.

## AHDA-$CsPbI_3$ QDs

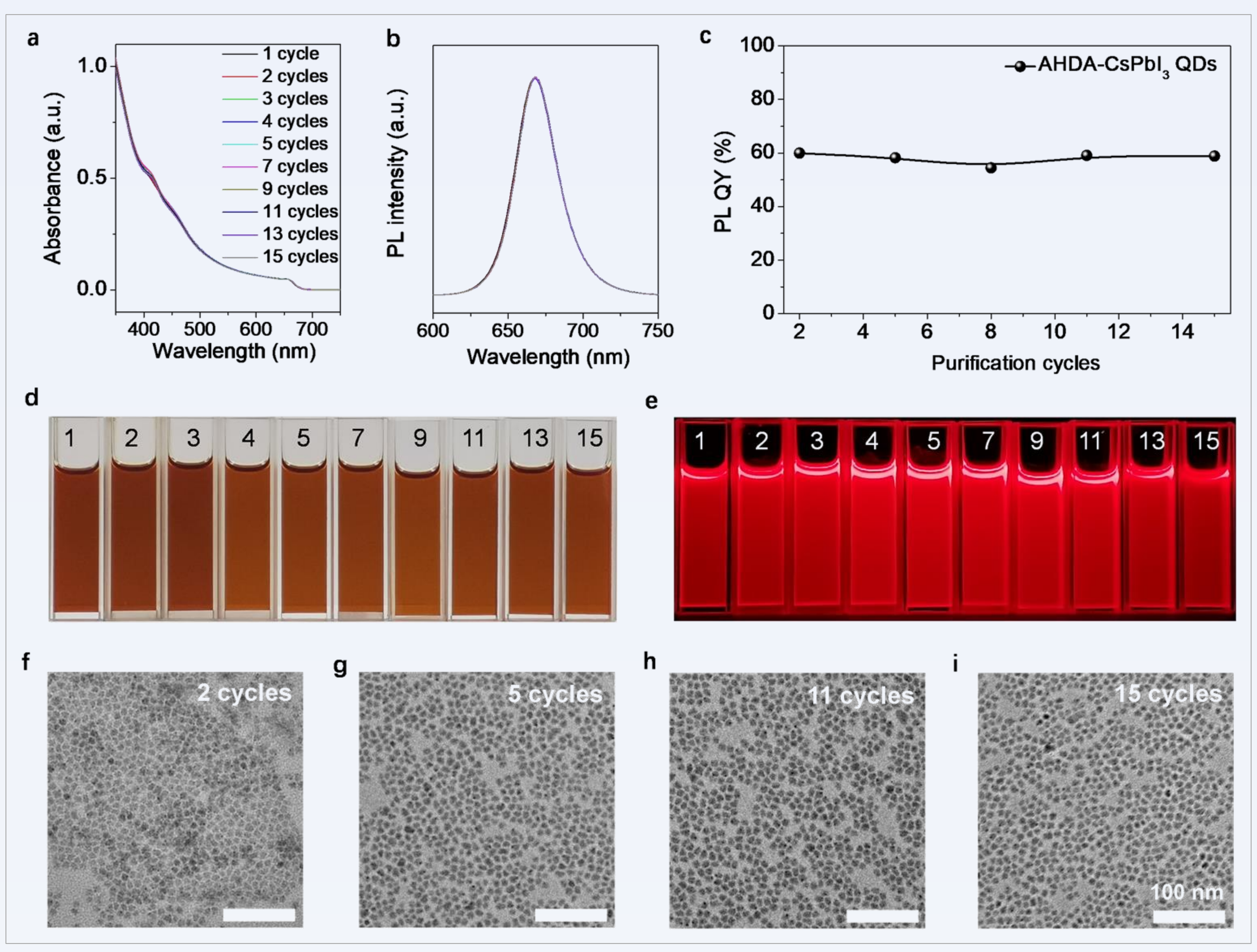


**Figure 1**. Record of optical properties and morphology over purification time.

## OLA-$CsPbI_3$ QDs

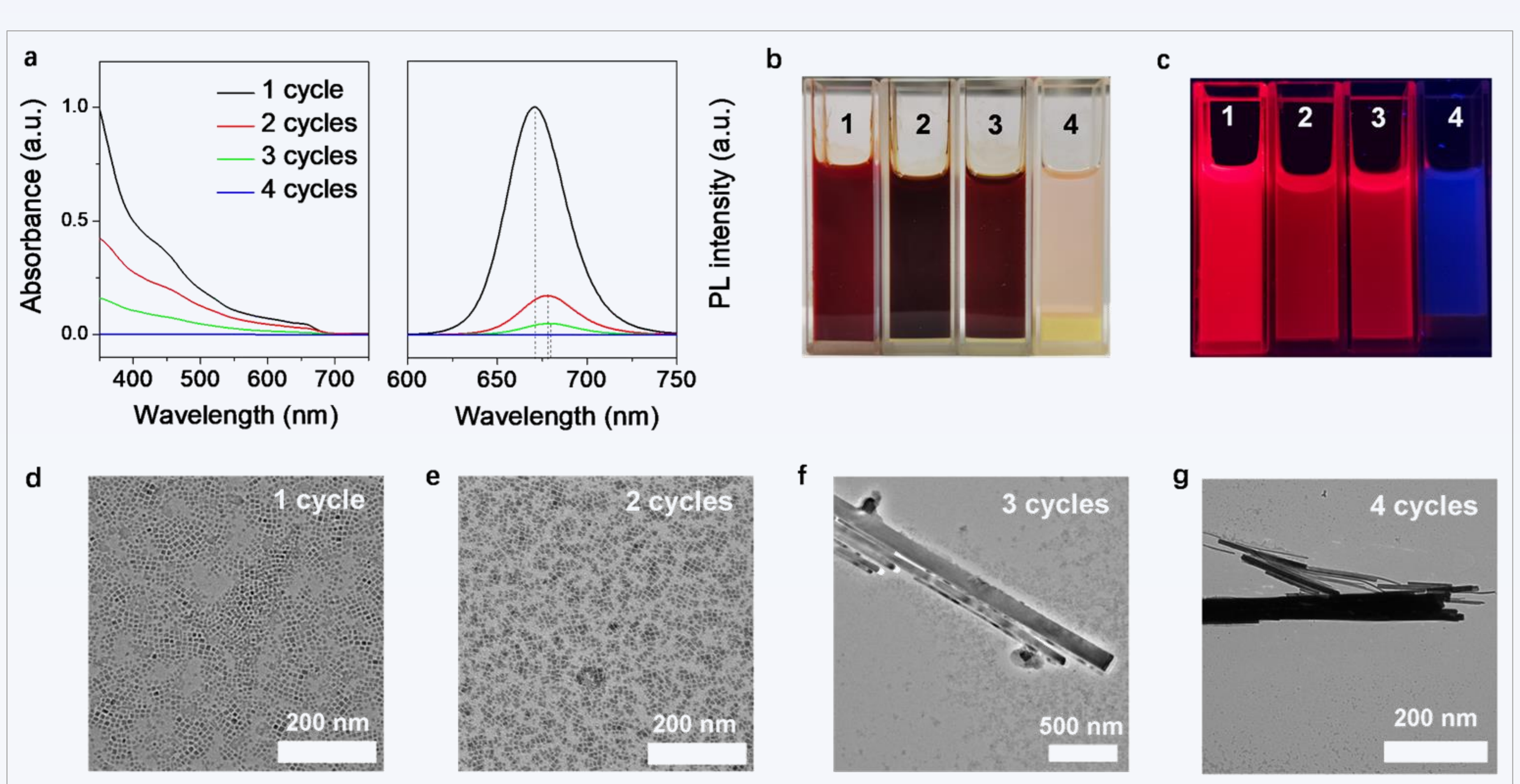


**Figure 2**. Record of optical properties and morphology over purification time.

## Phase stability

**85°C in air with relative humidity of 30-40%**

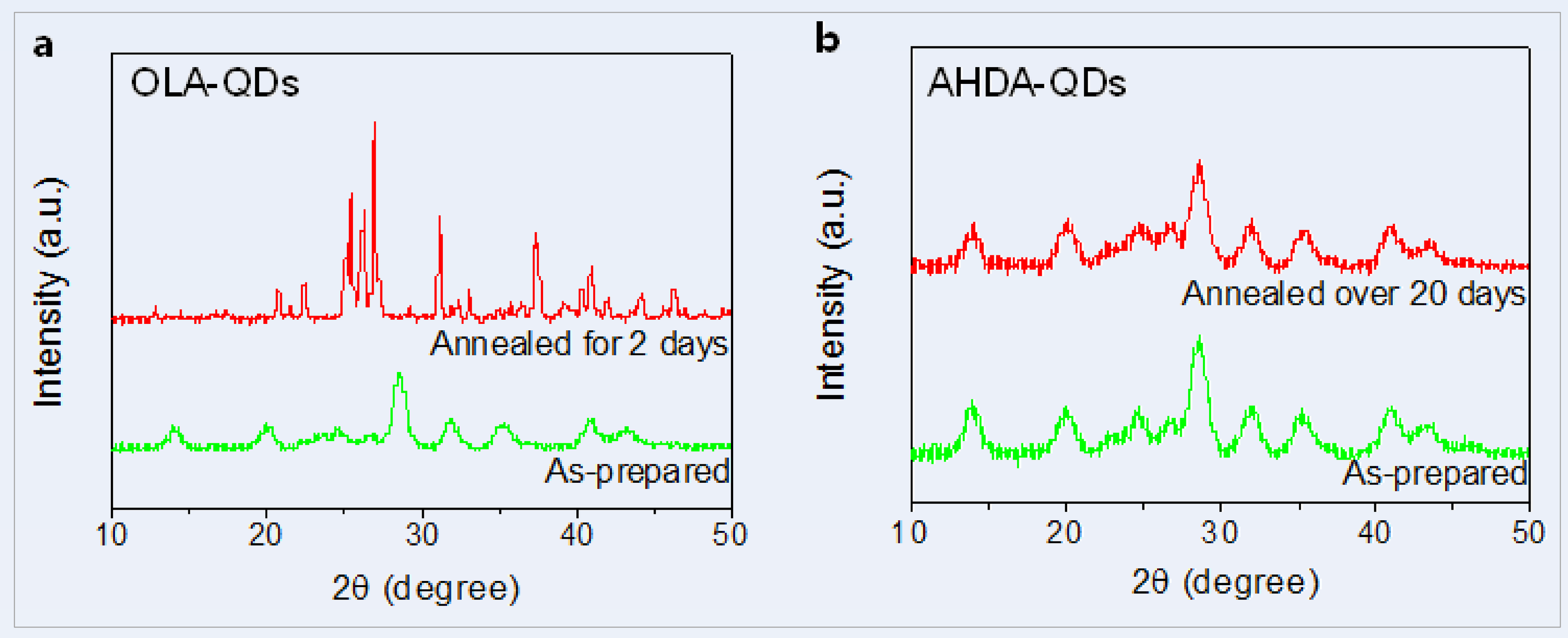


**Figure 3**. XRD patterns of OLA-$CsPbI_3$ and AHDA-$CsPbI_3$ QD film annealed at 85°C in air with relative humidity of 30-40%.

## Stabilizing mechanism

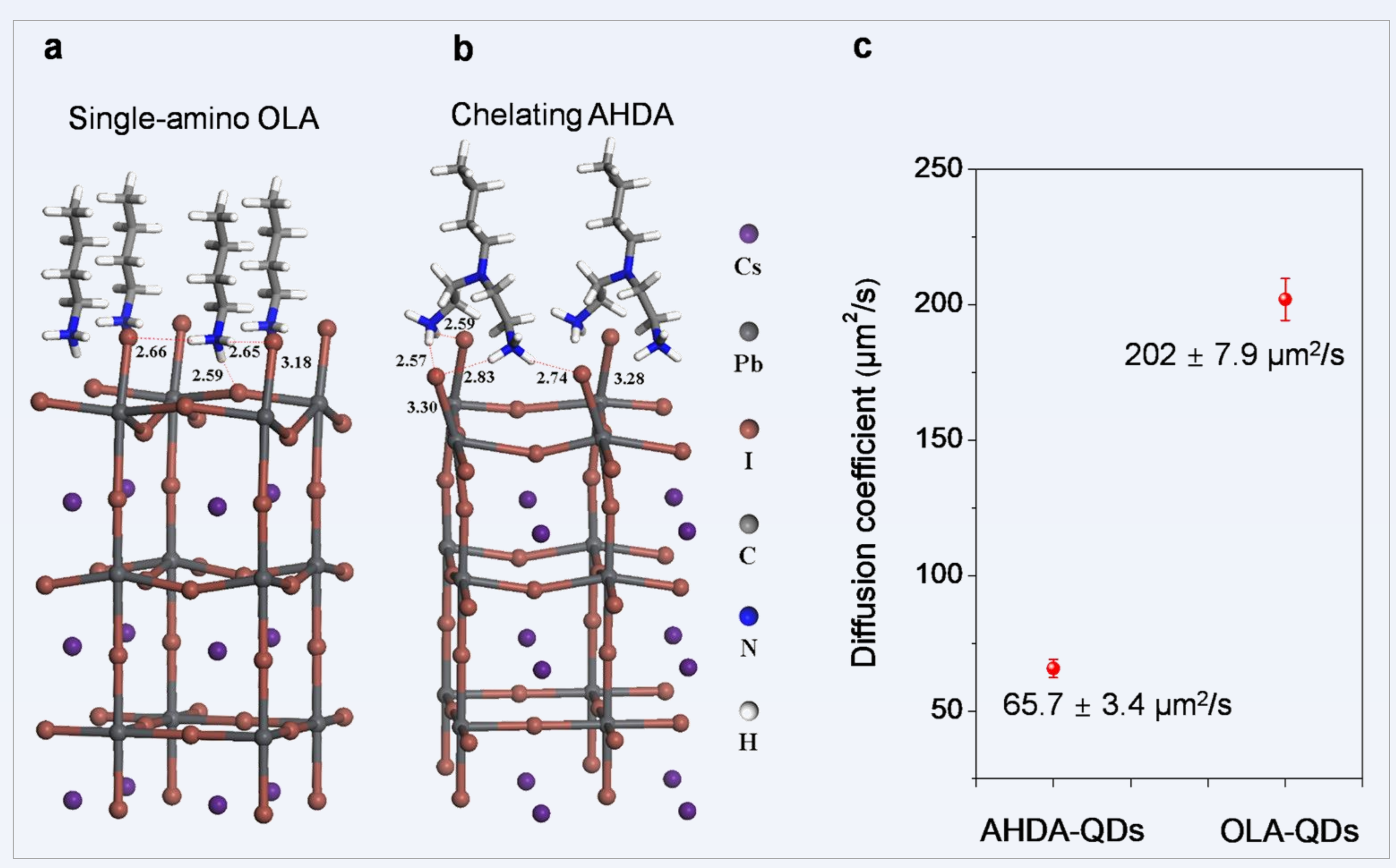


**Figure 4**. (a)-(b) Adsorption structures of OLA and AHDA on $CsPbI_3$(100) surface with labeled bond lengths (unit in Å). The binding energies of OLA and AHDA on $CsPbI_3$ edge are 1.47 and 2.36 eV, respectively. (c) Diffusion coefficients of OLA and AHDA capped QDs.

## Summary

The most labile $CsPbI_3$ QDs were used as a model system to test the effect of AHDA. AHDA can maintain the optical properties and morphology of $CsPbI_3$ PQDs for > 90 days, and even over 15 purification cycles. And the phase stability of AHDA-stabilized $CsPbI_3$ PQDs maintained for > 20 days, when annealed at 85°C in air with relative humidity of 30-40%. This robustness in $CsPbI_3$ PQDs is observed for the first time, indicating great potential of this ligands in preparing stable PQDs. The unprecedented stability of AHDA-QDs originates from the chelating effect allows to attach AHDA on PQD surface with high binding energy (BE) reaching 2.36 eV, much larger than typical values of 1.4 – 1.6 eV for the commercially available ligands.

参考文献

[1] De Roo, J.; Ibáñez, M.; Geiregat, P.; Nedelcu, G.; Walravens, W.; Maes, J.; Martins, J. C.; Van Driessche, I.; Kovalenko, M. V.; Hens, Z., Highly Dynamic Ligand Binding and Light Absorption Coefficient of Cesium Lead Bromide Perovskite Nanocrystals. *ACS Nano* **2016**, 10, 2071-2081