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Orbital-resolved polaron states in CdSe dots and rods probed by scanning tunnelling spectroscopy PETER LILJEROTH, ZHIXIANG SUN, INGMAR SWART, University of Utrecht, CHRISTOPHE DELERUE, IEMN- Dept. ISEN, DANIËL VANMAEKELBERGH, University of Utrecht — Despite the extensive knowledge of phonons in semiconductor crystals, the polaron states formed by the coupling between phonons and single electronic orbitals have not been measured directly due to the negligible spacing between the energy levels in conventional semiconductors. This can be overcome in semiconductor nanocrystals that have discrete energy levels due to quantum confinement. Here, we present scanning tunnelling spectroscopy results on CdSe rods and dots showing the single- electron polaron energy levels with their phonon replica. We measure the spacing and intensity of the replica, and derive the electron-phonon coupling strength for different orbital symmetries. The effect of multiple added electrons on the coupling strength can be assesses under shell-filling conditions. Our results show the formation of polaron eigenstates arising from Frhlich coupling of an electron to longitudinal phonons with a coupling strength that depends considerably on the size and shape of the nanocrystals. The results are important for understanding electron transport in zero and one-dimensional semiconductors and the intra-band relaxation of hot carriers in quantum dots.

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