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Optical properties of guest Na- and Rb-atoms in quasi-2D $M_{7.8}Al_{7.8}Si_{8.2}O_{32.0}$ (M = Na, Rb) from the perspective of polarons in a deformable lattice

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Guest Na and Rb atoms are introduced into a quasi-2D cage-type host with the chemical formula per unit cell $M_{7.8}Al_{7.8}Si_{8.2}O_{32.0}$ (M = Na or Rb). The cages contain a deformable lattice made up of cations (M), whose locations can change due to the interactions with the guest elements. The quasi-2D host framework has open zigzag channels along a- and b-axes, and a rather closed structure along the c-axis. At dilute densities of guest Na-atoms, optical absorptions are observed that indicate a rigid confinement of the guest electron's wave function within a single cage. At higher densities, changes in the absorption spectra indicate a possible extension of the excited state of the wave function to neighboring cages. At dilute densities of guest Rb-atoms, a low energy absorption is observed that may be explained by excitations to the p-like first excited-state with a wave length similar to the lattice constant. At higher densities, a new peak appears that may be explained in terms of surface plasmon excitations of many electrons within the zigzag channels. It is expected that, in addtion to the framework structure, the deformable lattice (in terms of the deformation potential energy provided by the lattice distortions of the deformable lattice coupled with the size of the constituent cations) has a crucial role to play in the evolution of optical properties in such materials. Polaron effects on optical properties require further considerations towards applications and theory.

Biography

Gayan Prasad Hettiarachchi has completed his PhD in Physics from Osaka University in 2015. He is currently working as a specially appointed Assistant Professor for the Insititute of NanoScience Design at Osaka University. He is interested in experimentally investigating strongly correlated electron systems in order to elucidate vital correlation effects and the underlying causes that ultimately lead to interesting physical properties and quantum phase transitions.

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