Tuning gap states at organic-metal interfaces by quantum size effects

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Abstract

Organic-metal interfaces are key elements to the organic-based electronics. The energy level alignment (ELA) between metal Fermi level and molecule orbital levels determines the injection barriers for the charge carriers at the interfaces, which are crucial for the performance of organic electronic devices. Dipole formation at the interfaces have been regarded as the main factor for ELA and several models were proposed for the mechanism of it in the context of the interface between organic molecules and bulk metal crystal surface, at which surface states were mostly used to probe the interfacial properties. We show that when the bulk metal crystal is replaced by a uniform metal thin film, another 2-dimensional electronic state, quantum well states, will not only be able to probe but also modify the interfacial electronic structures such as gap states, which don't have the counterpart at the organic-bulk crystal interface. Moreover, thickness-dependent quantum size effects of metal thin films provide a new method for engineering the organic electronic devices.