STM investigation on the surface structures of CeO_2 ultra-thin film

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Among all metal oxide materials, cerium oxide is one of the emerging topic in the field of heterogeneous catalysis for its role as non-innocent support and active co-catalyst. More precisely, its key property lies in the high mobility of lattice oxygen to be released/stored according to the atmosphere. In conjunction with the ability to promote noble metal catalysts, the atomic surface structure of ceria (CeO_2) has been extensively studied to reveal the atomistic mechanism in such properties, both for single-crystal surfaces and ultra-thin films on metal/semiconductor substrates. Here, ceria ultra-thin film (islands) on Pt(111) under various oxidation condition is investigated using low-temperature STM at 77K in UHV environment. In addition to well-known 1x1 CeO_2(111) surface, unprecedented ($\sqrt{3}$x$\sqrt{3}$)R30° phase was observed in atomic resolution. Both phases are in hexagonal lattice with vacancies, but show different electronic structures from empty-state imaging. The determining factor between two surface phases is likely to be the oxygen pressure during the oxidation, which is also correlated to the thickness of ceria islands for each phase. Available model structure and formation mechanism of each phase will be discussed.