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Metal and metal oxide nano-particles on quasicrystalline surface: A notable catalytic application in green energy

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Quasicrystals are complex in nature and it has been difficult to gain atomic scale understanding of catalytic activity of leached quasicrystals. Additionally, the underlying role of quasicrystals in the catalytic activity is yet to be understood. In order to achieve this information, we have attempted to create a simple model catalyst of nano particles on quasicrystalline surfaces by leaching well defined surfaces of single grain quasicrystals. As the first step of these studies, we present here the effect of leaching treatments on surface morphology and chemical composition of different Al-based quasicrystals studied by scanning electron microscopy (SEM), energy dispersive X-ray (EDX) analysis and X-ray photoelectron spectroscopy (XPS). The high symmetry surfaces of single grain icosahedral (i)-Al-Cu-Fe and decagonal (d-) Al-Ni-Co, (d)Al-Cu-Co quasicrystals and a polygrain (i)-Al-Pd-Re, (*i*)-Al-Cu-Fe, (*i*)-Al-Pd-Mn quasicrystal with random surface orientation were leached with NaOH solution at varying times and the resulting surfaces were characterized by scanning electron microscopy, energy dispersive X-ray analysis and X-ray photoelectron spectroscopy. The leaching treatments preferentially remove Al producing nano-particles of the transition metals and their oxides. The leached fivefold surface of i-Al-Cu-Fe exhibits micron sized dodecahedral cavities on which the nano-particles are precipitated. However, no specific microstructure has been observed on the tenfold surface of d-Al-Ni-Co and the polygrain i-Al-Pd-Re. Quasicrystalline surface can be regained after polishing the leached layer, indicating that leaching occurs only in a limited depth from the surface. The 2 hour leached as grown and mechanically activated Al-Cu-Fe alloys was subjected for catalyst application in hydrogen storage materials. The catalytic effect of leached alloy on the de/rehydrogenenation characteristics has been studied. The hydrogenation behavior including absorption kinetics will be discussed and presented in detail.

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