2D Metals for Catalysis

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The initial discovery of graphene and other 2D materials ignited interest from catalysis researchers because 2D materials are comprised entirely of surface atom*s* - the atoms on which chemical reactions occur on solid catalysts - and because the unique electronic properties of 2D materials are expected to drive unique chemical reactivity. However, interest waned due to the difficulty of synthesizing 2D forms of metals and their alloys – the critical components of industrial catalysts. Examples have emerged very recently on 2D "metallenes" (metals of thickness less than 5 nm); however, catalytic properties have been studied at modest reaction temperatures and mainly in liquid media. In this work, we study 2D metals grown by confinement heteroepitaxy (CHet) for catalysis. The quantum confinement, mechanical strain, and asymmetric chemical bonding that distinguish 2D metals from their bulk counterparts are all properties known to impact catalytic reactivity, and we therefore expect 2D metals to show catalytic activity that is different from the bulk. The synthesis of 2D metals on SiC particles will be covered, along with the first look at CO desorption from 2D Ga. Lastly, I will show evidence of significant charge carrier tuning in 2D metals that could potentially be exploited to control reaction barriers – an approach that is industrially relevant for driving reactions via electricity generated from renewable sources.