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Nanoporous Systems: Metallic Muscles at Work

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In recent years nanoporous metals have attracted considerable attention due to their potential for various applications, including catalysts, sensors, actuators, supercapacitors, nanofilters, and drug delivery platforms. Also metallic muscles can be made of nanoporous metals with high surface-area-to-volume ratios that exert work due to changes in their interface electronic charge density. First, we have discovered that a layered architecture can be exploited to enhance the functional properties of nanoporous materials. As an illustration, we will show that the charge-induced strain response of nanoporous metals like Au,Ag,Cu with a layered morphology is amplified by roughly two orders of magnitude. However, still they suffer from serious drawbacks caused by the usage of an aqueous electrolyte needed to modulate the interface electronic charge density by injection of electronic charge at the nanoporous metal/electrolyte interface. Here we present a new electrolyte-free approach to put metallic muscles to work via a metal/polymer interface. Strain rates achieved in the single-component heterojunction actuator are four orders of magnitude higher than that of the standard three-component nanoporous metal/electrolyte hybrid actuator.