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Highly Stretchable MoS2 and Phosphorene Kirigami DAVID CAMPBELL, PAUL HANAKATA, HAROLD PARK, Boston University — Several recent works have shown how nanomesh and kirigami patterning can be used to increase the ductility of monolayer graphene and thin film electrodes, suggesting that this approach should be useful for other 2D materials. We have studied the effects of kirigami patterning on the mechanical properties of MoS2 and phosphorene "monolayers," using classical molecular dynamics simulations. We have explored several different kirigami structures, focusing on two simple non-dimensional parameters found to be relevant in our previous study of graphene [1]. These parameters are related to the density of cuts and to the ratio of the overlapping cut length to the nanoribbon length. We found that these membranes, despite not having the single atomic layer planar structure of graphene, show a significantly enhanced ductility that can be understood in terms of the two geometric parameters. For instance, fracture strains of MoS2 kirigami can be enhanced by a factor of six relative to pristine MoS_2 nanoribbons. Our findings suggest that the kirigami cuts are the key to changing the morphology of 2D membranes to allow out of plane deflection and to prevent early failure. [1] Zenan Qi, David K. Campbell, and Harold S. Park, Phys. Rev. B 90, 245437 (2014). .

David Campbell
Boston University

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