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ABSTRACT

Chemical Functionalization of Segregated Germanene on Ag(111)/Ge(111)

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Germanene, a graphene-like two-dimensional sheet of germanium (Ge), has attracted immense attention owing to its theoretically predicted outstanding 2D topological properties [1]. However, unlike graphene, germanene is easily oxidized in air, making it difficult to realize electrical devices using germanene [2]. To overcome the drawback of the chemical stability of germanene, it is necessary to understand how germanene is oxidized. Also, chemical functionalization is expected to be an effective strategy for providing antioxidant functionality to germanene, although no experimental studies have been reported. Among the possible approaches, hydrogenation is a promising candidate due to its potential to enhance the chemical stability of germanene.
Here we report our investigation of the oxidation and hydrogenation reactions of germanene, including an evaluation of their thermal stability. In this study, germanene was synthesized via the segregation method from an Ag(111) thin film deposited on a Ge(111) substrate. Our oxidation study revealed that germanene can be reformed from its oxidized phase through vacuum heating. Careful investigation revealed that the desorption of Ge oxides is the key reaction in the reformation [3]. Hydrogenation studies revealed a continuous change from GeH (monohydride) to GeH3 (trihydride) evidenced by Fourier transform infrared spectroscopy. We are the firtst to demonstrate the reversible hydrogenation and dehydrogenation of monolayer germanene. The details of this study will be reported and discussed in the presentation.

[1] M. Ezawa, J. Phys. Soc. Jpn., 84, 121003 (2015).
[2] S. Suzuki et al., Adv. Funct. Mater., 31, 2007038 (2021).
[3] S. Suzuki et al., Small Methods, 9, 2400863 (2021).