ゼロCO_2エミッション機能性材料開発研究センター
R&D Center for Zero CO_2 Emission with Functional Materials

エネルギー物質科学研究センター
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“2D materials as protection coating for unconventional environments”

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Corrosion has been estimated to cost the U.S. ~3% of GDP and, extrapolated worldwide, represents a drain of trillions of dollars on the economy annually. Atomically thin layers of graphene have been proposed to protect surfaces through the direct blocking of corrosion reactants such as oxygen with minimal alternation to the protected material performance. The high degree of anti-corrosion performance by atomic thinness is attractive for number of applications under unconventional environments. An example is protection of electron source for particle accelerators. High quantum efficiency semiconductor photocathodes consist of alkali elements thus ultrahigh vacuum of 10^{-10} Torr/10^{-8} Pa is required to maintain their performance. To protect such surfaces, not only the coatings need to exhibit high gas barrier performance but they also need to be atomically thin to allow the photoelectrons to efficiently escape into vacuum. Another example is protection of actinides for nuclear applications. The systems often cannot tolerate impurity inclusion at ~micrometer thickness of conventional coatings thus the coatings need to be ~nanometer thick. In this presentation, I will introduce our progress towards above two applications. On protection of electron source for particle accelerators, we demonstrated 3 orders of magnitude increase in active pressure of alkali antimonide semiconductor photocathodes and won R&D 100 award in 2019. We recently started on protection of actinides, and demonstrated an enhancement of lifetime against hydrogen corrosion.

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