Failure of multi-layer graphene coatings in acidic media - DTU Orbit (08/11/2017)

Failure of multi-layer graphene coatings in acidic media

Being impermeable to all gases, graphene has been proposed as an effective ultrathin barrier film and protective coating. However, here it is shown how the gastight property of graphene-based coatings may indirectly lead to their catastrophic failure under certain conditions. When nickel coated with thick, high-quality chemical vapor deposited multilayered graphene is exposed to acidic solutions, a dramatic evolution of gas is observed at the coating–substrate interface. The gas bubbles grow and merge, eventually rupturing and delaminating the coating. This behavior, attributed to cathodic hydrogen evolution, can also occur spontaneously on a range of other technologically important metals and alloys based on iron, zinc, aluminum and manganese; this makes these findings relevant for practical applications of graphene-based coatings.Being impermeable to all gases, graphene has been proposed as an effective ultrathin barrier film and protective coating. However, here it is shown how the gastight property of graphene-based coatings may indirectly lead to their catastrophic failure under certain conditions. When nickel coated with thick, high-quality chemical vapor deposited multilayered graphene is exposed to acidic solutions, a dramatic evolution of gas is observed at the coating–substrate interface. The gas bubbles grow and merge, eventually rupturing and delaminating the coating. This behavior, attributed to cathodic hydrogen evolution, can also occur spontaneously on a range of other technologically important metals and alloys based on iron, zinc, aluminum and manganese; this makes these findings relevant for practical applications of graphene-based coatings.

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