Challenges for continuous graphene as a corrosion barrier

Corrosion, the degradation of metals and alloys by chemical and/or electrochemical means, is a great challenge to society, its industries and its citizens, both in terms of economics, safety and health. Corrosion barrier technology can be regarded as a special case of the more general problem of preventing the transport of matter towards a certain target. For instance, many electronic devices based on organic compounds, such as OLEDs and organic solar cells, deteriorate rapidly in air due to reactions with oxygen and water vapour. Likewise, air exposure will cause food to alter its taste, colour and/or texture. A common solution for this type of problem is to use a barrier layer that limits or blocks the transport of corrosive or oxidative species from the environment to the target. Graphene and several other 2D materials have excellent impermeability, high mechanical properties, and chemical and thermal stability. While graphene has been proposed as a barrier coating for a range of scenarios, graphene-based barrier layers face a number of limitations and challenges that must be considered, depending on the application. In this review, we present a comprehensive overview of these potential roadblocks for graphene-based coatings—and related 2D materials—to aid research in this direction, and promote the development of ubiquitous, cheap and powerful barrier technologies based on such ultrathin materials.