The study of corrosion of copper protected by graphene coatings

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Copper is widely known to exhibit nearly outmatched electrical and thermal conductance. Because of it, this metal is widely used in electronic industry in form of wires or heatsinks. However, in the ambient atmosphere the surface of copper interacts with air molecules and the layer of oxides is formed. As the conductive properties of the oxides of copper are far inferior to those of the metal in its pure state, means of the corrosion prevention are often being taken. The side effect of nearly all of the methods is the controlled degradation of the properties of copper and in case of coatings – increase of the dimensions of the device.

One of the most promising methods for corrosion inhibition for copper is graphene coating due to impermeability of single sheets to gases [1]. The graphene is very attractive as not only it is good conductor for heat and electricity by itself, but it also can withstand high pressures. Also, using the CVD method it can be grown directly on copper surface. Because of this, the graphene is believed to be one of the most promising corrosion inhibiting coatings for copper.

The CVD graphene grown on the surface of copper is not continuous, however. Instead, it is composed of numerous islands, which are either not connected to each other, or their joint boundaries are heavily defected due to misalignment of the lattices of the islands. These areas serve as the gateways for the air molecules, and in the proximity of those areas the corrosion reactions are enabled [2]. We present our investigation of this phenomenon. We show that while globally the amount of copper oxides in air exposed graphene-coated copper negligible, during the nanoscale investigations by STM/STS signs of corrosion can be found. We show the characteristic of those changes and alterations in the local electronic structure of graphene-coated copper they introduce.

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References

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