

Advanced Nanotechnology 2019: Corrosion protection with graphene - Bernhard Munzing - The Sixth Element (Changzhou) Materials Technology Co. Ltd, China**Bernhard Munzing***The Sixth Element (Changzhou) Materials Technology Co. Ltd, China*

Graphene can now be produced on large industrial scale. Most of these processes generate few layer graphene. This sets the focus on how graphene can be incorporated into industrial applications. The Sixth Element has established a proprietary process to manufacture different types of graphene with specific designed properties for different applications. Products of Sixth Element are registered according REACH. Research on how using graphene in coatings started 2013 focusing on reducing zinc in solvent based corrosion protection primers. In standard primers with high zinc content, zinc acts as cathodic sacrifice layer, as zinc is the more ignoble metal, therefore protecting the underlaying metal substrate. When the zinc is oxidized, the resulting zinc oxide builds up a barrier, which prevents the attack of the surrounding media to the metal substrate. The idea was to design a graphene type, being electrical conductive enough to support any cathodic function of the system and able to act as a barrier without producing a battery cell. A further requirement was that such a graphene can be processed with standard equipment used in the coating industry. Cooperating with an industrial partner in China, Toppen Co, the graphene type SE1132 was

developed, a few layer graphene with a medium conductivity. Addition of 1% SE1132 to an epoxy primer system and reducing the zinc content to 25% (based on dry substance) show significant improvements in salt spray testing and water condensation testing compared to a standard zinc rich epoxy primer. The results have been confirmed by measuring the corrosion current of such a system. The 1% addition shows the lowest current. In China Sixth Element has received a patent for this development. Based on independent tests of Chinese authorities the system containing 1% graphene (based on dry substance) is approved for off-shore applications. The system was first applied to protect the steel construction of an off-shore wind energy tower in 2015. Meanwhile more off-shore projects have used this system. Contrary to this, in Europe the development of such systems is in the prototyping stage. Based on these findings, prototypes of water-based and powder coating systems have been developed; showing that graphene also in these systems enhances corrosion significantly. Development of commercially available products is ongoing. An update on latest developments will be given at the conference.