



## Norbert Fabricius<sup>1</sup>

Alexandra Fabricius<sup>2</sup>

<sup>1</sup>DKE – German Commission for Electrical, Electronic & Information Technologies of DIN and VDE, Frankfurt, Germany

<sup>2</sup> KIT - Karlsruher Institut für Technologie, Eggenstein-Leopoldshafen, Germany

# International Standardization on Graphene and related Materials

Since the Nobel Prize in Physics was awarded to Andre Geim and Konstantin Novoselov in 2010 for their ground breaking experiments on graphene, this material was the subject of intense research efforts. This has led to a quite good understanding of the basic properties of graphene and related materials. Nevertheless, it remains difficult to purchase these materials with consistent properties which hinders their broad use in industrial low-cost and large-scale manufacturing. For the successful dissemination of research results and their transfer into commercial applications, it is essential to develop consensus-based international standards which define the material properties most important for industrial use and provide measurement protocols to measure them consistently across the whole supply chain.

This standardization process is performed as a joint effort of IEC, ISO, CENELEC and IEEE and revolves around a central document, the standard IEC 62565-3-1. This so-called Blank Detail Specification provides a template which lists all relevant material properties (Key Control

Characteristics: KCC) and the standardized measurement protocols to measure them. There are currently 36 KCCs specified in the Blank Detail Specification including “number of layers”, “sheet conductance”, and “transmission”. IEC 62565-3-1 is intended to define the state of the art of graphene specification and support industrial users to write a sectional material specification for their particular application. Therefore, it is expected that, after the publication of edition one early in 2016, an edition two of the standard will follow soon to reflect the technological progress. It is also expected that the Blank Detail Specification for graphene will be exemplary for similar standards regarding other 2D materials.

IEC, ISO, CENELEC, and IEEE are working in parallel on measurement standards for the KCCs listed in IEC 62565-3-1. This includes the customization of existing measurement standards for their application in graphene-related technologies as well as the development of new standards where necessary. All these activities are well linked together to ensure the establishment of a





comprehensive system of standards for graphene-based technologies to support them on their way to industrial applications.

This talk will provide a review of the international standardization on graphene and present the status reached within the IEC, IEEE and ISO nanotechnology committees and the recently established CENELEC Workshop on “Specifications for

Graphene Related Materials (CENELEC WS SGRM)”. It will point out the importance of standardization for the commercialization of graphene-based technologies, highlight the crucial role of industry in this process and give an overview over what kind of services IEC and ISO provide to make this investment most efficient for their stakeholders.

