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LA-ICP-MS analysis of Deuterium in polymers for assessment of the water content

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Polymers cover a wide range of favorable physical and chemical properties that are of utmost relevance for highly demanding applications. In electronic devices, polymers are often used as coating or encapsulation material which requires both high chemical and physical resistance but also insulating properties. However, in the course of the component's use, the polymers physical and mechanical properties can change massively, causing the protective/insulating effect of the coating/encapsulation to be lost over time, which in extreme cases can lead to device failure. A parameter known to significantly influence the degradation of polymers is the water content, which is usually determined using indirect procedures such as thermo-gravimetric analysis, differential thermal analysis, or dynamic vapor sorption [1]. Although well established, these techniques are connected with severe drawbacks, such as the limitation to bulk investigations and the bias caused by the release or uptake of other volatile species.

In this contribution, a new approach for the assessment of the water content in polymer samples is presented. The developed procedure is based on the preliminary treatment of a dried polymer sample with Deuterium enriched water (D_2O), and the subsequent LA-ICP-MS analysis of the Deuterium content in the polymer, enabling a reliable determination of the water uptake. Measurement of Deuterium is performed by monitoring the signal from the polyatomic ArD ion formed in the plasma, an approach which has been presented recently by Galbacs et. al for the ICP-MS analysis of Deuterium in liquid water [2]. For the conducted LA-ICP-MS investigations, a special ablation chamber has been constructed, which allowed to reduce the influence of remaining humidity. Moreover, a thorough optimization of the ablation parameters was necessary. Pressed pellets made from polymer powders containing defined supplements of deuterated organic compounds have been used as calibration standards, demonstrating a linear correlation between the measured ArD signal and the Deuterium content of the sample, enabling spatially resolved measurements of Deuterium in polymers down to the permille range.

LA-ICP-MS, Deuterium, polyatomic ions, polymers, water content

Bley et.al., J. Pharm Sci. 2009 (98), 651-664.

Galbacs et al., Analytica Chimica Acta 1104 (2020) 28-37.