Investigating luminescence-based radiation dosimeters using EPR methods

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Solid state luminescence dosimetry developed considerably since the 1960s and is used for a wide range of applications, such as personnel, medical and environmental ionizing radiation dose assessment. Thermoluminescence (TL), Optically Stimulated Luminescence (OSL) and Radiophotoluminescence (RPL)-based methods and detectors all have their typical properties (sensitivity, dimensions, linearity, energy response, …) making them suited for specific purposes[1-3].

EPR is also known as a reliable dosimetric technique, using e.g. alanine, tooth enamel and sucrose for retrospective/accident dosimetry, detection of irradiated food, etc. Although EPR can, in general, not compete with the luminescence methods mentioned above, it can provide complementary insight into the defects and processes leading to luminescence.

In the present study we discuss results on two classes of materials, i.e. LiF:Mg,Ti /LiF:Mg,Cu,P and Al_2O_3:C /Al_2O_3:Mg,C relevant for TL and OSL/RPL respectively. All samples were measured in X- and Q-band both before and after X-ray irradiation. In powder samples of LiF:Mg,Cu,P a strong signal was detected (Fig. 1) that did not show (X)-radiation sensitivity. Upon irradiation also no other signals could be detected. The signal shown below or a very similar signal has been tentatively identified in literature[4] as related to Cu^{2+}, although its characteristics are not evidently compatible with such an assignment. Therefore further investigation appeared necessary and the first ENDOR experiments look promising. The Al_2O_3-based and LiF:Mg,Ti powder samples have no significant EPR signal present before irradiation, but do reveal a signal after irradiation. The present status of the research will be discussed.

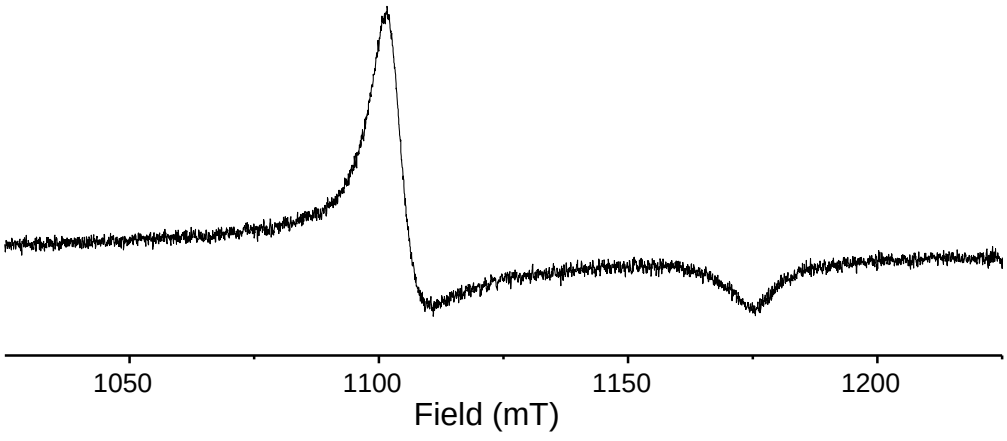

Figure 1: Q-band spectrum of LiF:Mg,Cu,P powder before irradiation.

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