ID: MSCA-19-VandenBrande01

Discipline: Chemistry

Title: Development of fast scanning and AC chip calorimetry for sustainable material applications

Abstract: In recent years, the Physical Chemistry and Polymer Science (FYSC) group has successfully investigated thermoplastic materials for e.g. organic solar cells with fast scanning chip calorimetry. This advanced thermal analysis technique allows for direct analysis of submicron layers at high scanning rates (up to $10^6$ K/s) by using thin membrane chips, making it possible to analyze “true” isothermal structure formation of both pure materials and mixtures. Given the thin layer nature of most organic electronic systems, as well as functional coating, this technique is highly suited for the study of phase behavior in these modern systems. This topic aims at expanding the available chip calorimetry infrastructure and expertise in several ways.

AC chip calorimetry will now be introduced. AC chip calorimetry allows to obtain heat capacity information in thin layer samples, by using the same thin membrane chips as in fast scanning chip calorimetry. AC chip calorimetry will first be implemented as a separate device, but the end goal is an instrument capable of both measurement modes (fast scanning and AC).

Hardware and software improvements will lead to a more user-friendly and mobile device, allowing it to be combined with complementary analysis techniques such as e.g. atomic force microscopy (AFM) and x-ray diffraction (XRD), and leading to in-situ thermal analysis. The feasibility of combining the device with (sub)THz sensing will also be investigated. Novel THz sensor technology has a high potential as analytical tool for monitoring phase transformations contact-free, non-destructive and in real-time (sub-ms scale). In the LAMI (VUB) research group, breakthroughs have been realized at the level of sensitivity by means of very advanced sensor configurations.

Depending on the qualifications of the researcher, different aspects of this ambitious project can be selected to receive more attention, giving the researcher the option to specialize in the aspect of his choosing within the limits of the project. During this project, the researcher will be collaborating with PhD students, who focus on sustainable material systems for organic electronics and reactive self-healing applications, respectively. As such, model systems from these fields can be investigated. Additional support will be given by a highly qualified electronics expert.

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