

Ultrafast Melting Properties of Natural Cyclodextrins

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Natural cyclodextrins (CDs) are a class of cyclic oligosaccharides having molecular cavities. CDs are widely used in pharmaceuticals, cosmetics, food and textile industry, catalysis, chromatography. Undoubtedly, such important substances as cyclodextrins require accurate knowledge of fundamental thermodynamic properties: melting points and corresponding enthalpies. Such data are essential for understanding and predicting of properties based on structure-property relationships; for calculations on the energy of the crystal lattice, which has a crucial effect on inclusion properties; for evaluation of the limiting temperatures during the modification of drug complexes by fast heating and cooling. At the same time, the melting points and corresponding enthalpies cannot be measured by conventional methods, since solid CDs decompose without melting at temperatures less than 300 °C.

The present study is focused on the determination of the melting parameters and high-temperature behavior of natural cyclodextrins using fast scanning calorimetry (FSC). Melting points of α -, β - and γ -cyclodextrin were determined for the first time using FSC with heating rates up to 40000 K·s⁻¹, also as melting enthalpy of γ -cyclodextrin. The activation energies of thermal decomposition of cyclodextrins were calculated from the temperature dependence at wide range of heating rates.

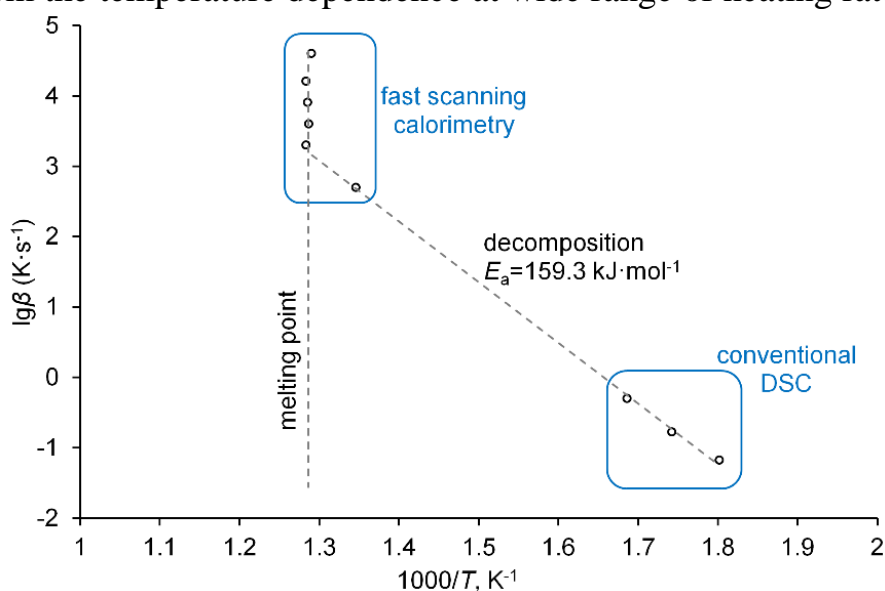


Fig. 1. Dependency of onset temperatures (T) of main exothermic peak for anhydrous α -cyclodextrin on heating rate (β) in Flynn–Wall–Ozawa analysis coordinates.

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