Polymeric phase-change materials: applicability and long-term stability

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Thermal energy storages reduce the mismatch between energy supply and demand and are essential for lowering CO_2-emissions. Phase-change materials (PCM) are preferably applied as storage material due to their high energy density and their melting/crystallization transition is used to store and release thermal energy. Polymeric candidate materials are HDPE, PP and PA 6 and their recyclates as they exhibit high heat of fusion ΔH_M (i. e. the storage capacity) and cover a broad application temperature range (characterized via DSC).

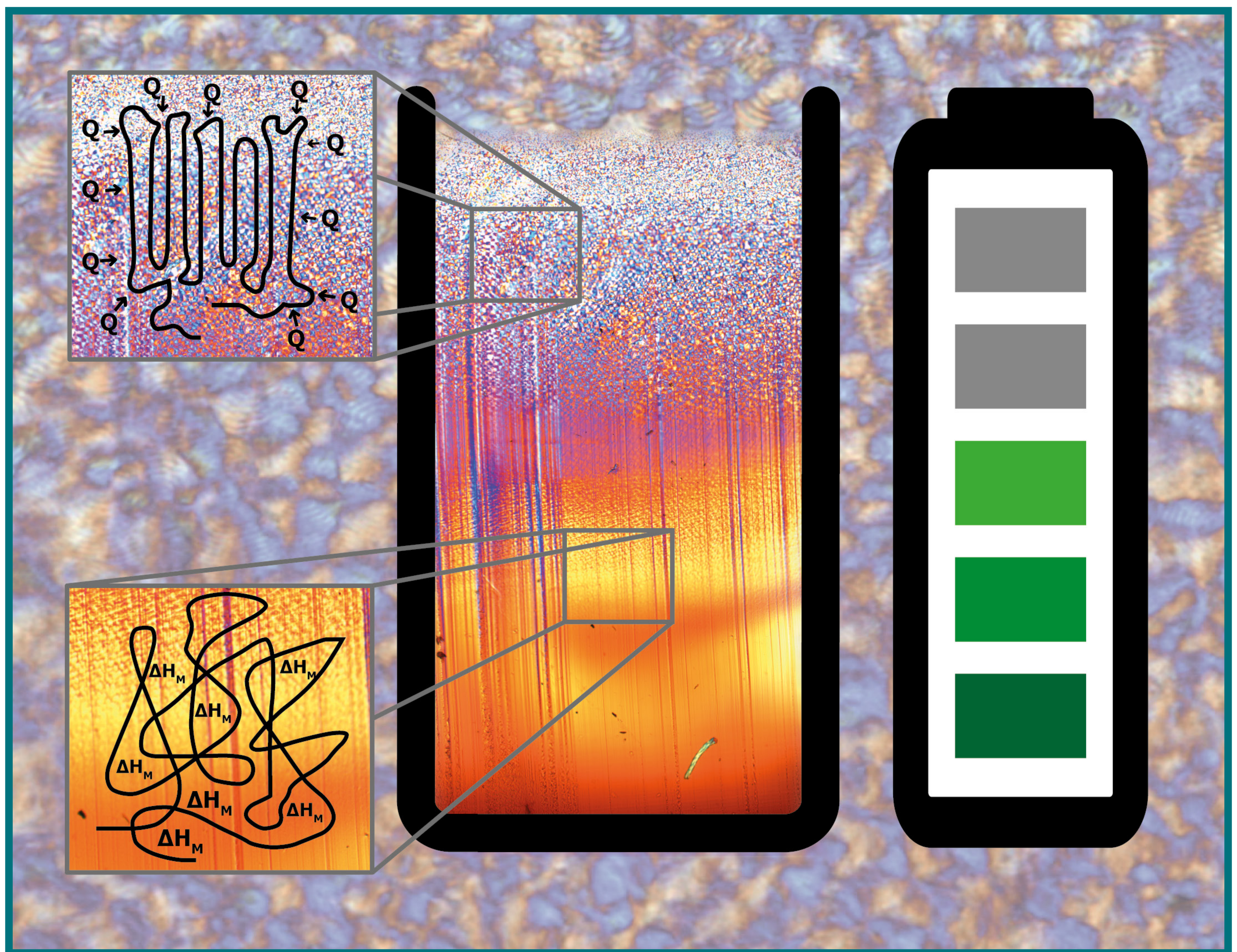

Fig. 1: Thermal energy Q is stored and released during the melting/crystallization of semi-crystalline polymers such as HDPE, PP and PA 6. The heat of fusion ΔH_M corresponds to the polymer's storage capacity.

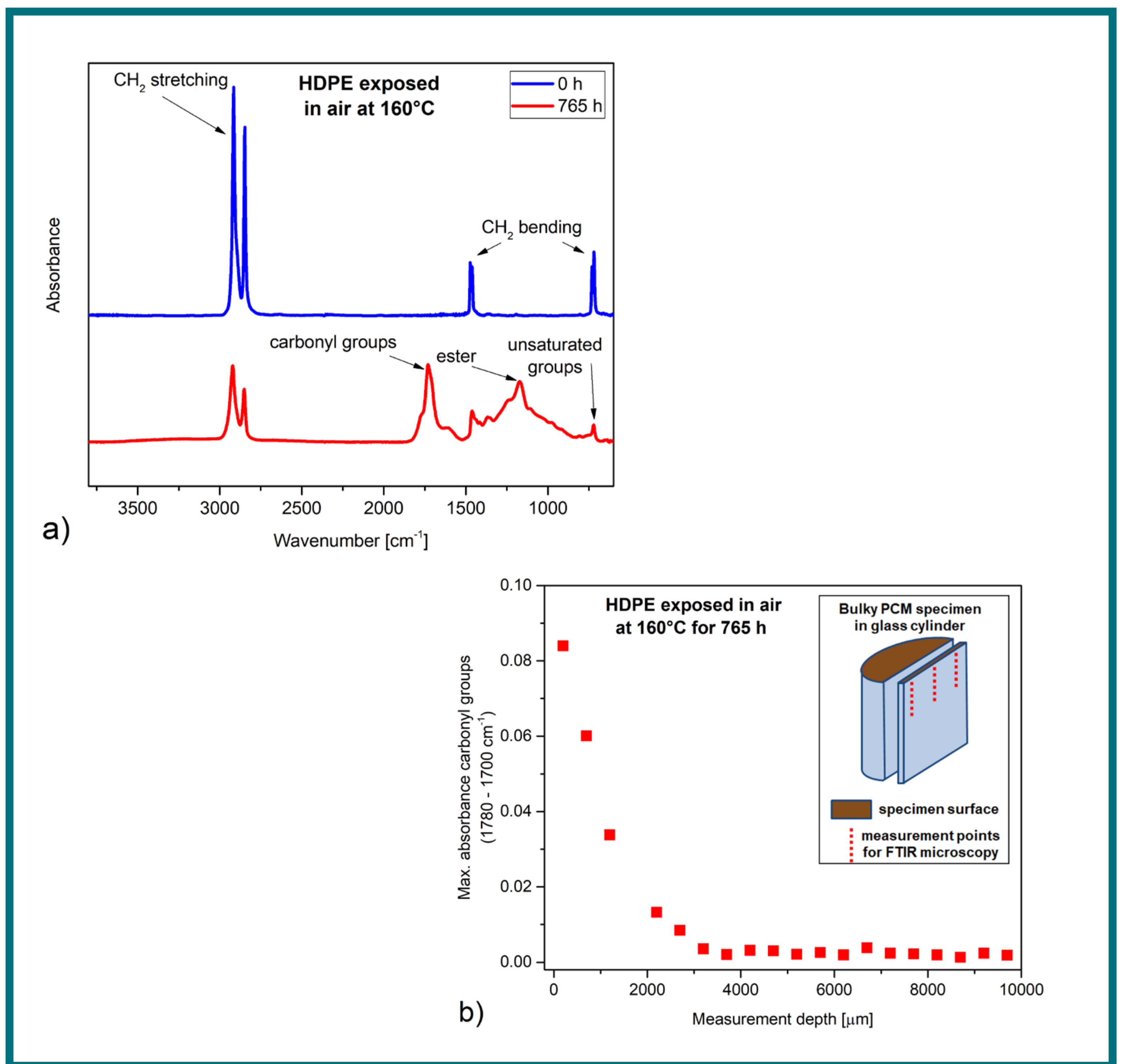

Fig. 2: a) FTIR spectra of unexposed and exposed HDPE: carbonyl build-up due to thermo-oxidative degradation. b) Carbonyl build-up decreases from the surface into the bulk due to diffusion-limited oxidation

During their application, PCMs are exposed to severe conditions (atmospheric oxygen in the melt state). With increasing carbonyl build-up (monitored via FTIR), the crystalline morphology and thus the storage capacity are affected. Nonetheless, due to diffusion-limited oxidation, the carbonyl build-up decreases rapidly when going from the surface into the bulk. Thus, the majority of the polymer's storage capacity is maintained during its application as PCM.

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RESEARCH FOCUS: functional polymers with selective transfer and transport characteristics, thermal properties and ageing of polymers, polymeric latent heat storages

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