

STRUCTURAL AND THERMAL CHARACTERISATION OF POLY(ETHYLENE OXIDE) BLENDS WITH CALCIUM ALGINATE



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ABSTRACT

Modification of poly(ethylene oxide) (PEO, Sigma-Aldrich, Inc.) was carried out by adding calcium alginate (CaAlg, Qingdao Hyzlin Biology Development Co., Ltd.), as a natural polymer, to prepare new polymer blends that can be potentially used as polymer electrolyte in Ca batteries. The samples were prepared by extrusion in twin-screw extruder (HAAKE MiniLab 3, Thermo Scientific) with circulation channel. Structural features, in terms of crystalline structure and interaction between components of the blends, have been investigated using X-ray diffraction (XRD, Empyrean diffractometer system, Malvern PANalytical) and Fourier transform infrared microscopy (FTIR-microscopy, Spectrum Two, Perkin-Elmer), respectively. Thermal properties and thermal stability were investigated by using differential scanning calorimetry (DSC, DSC 823^e, Mettler-Toledo) and thermogravimetry (TG, Pyris 8000 TGA , Perkin-Elmer).

RESULTS

Infrared spectroscopy

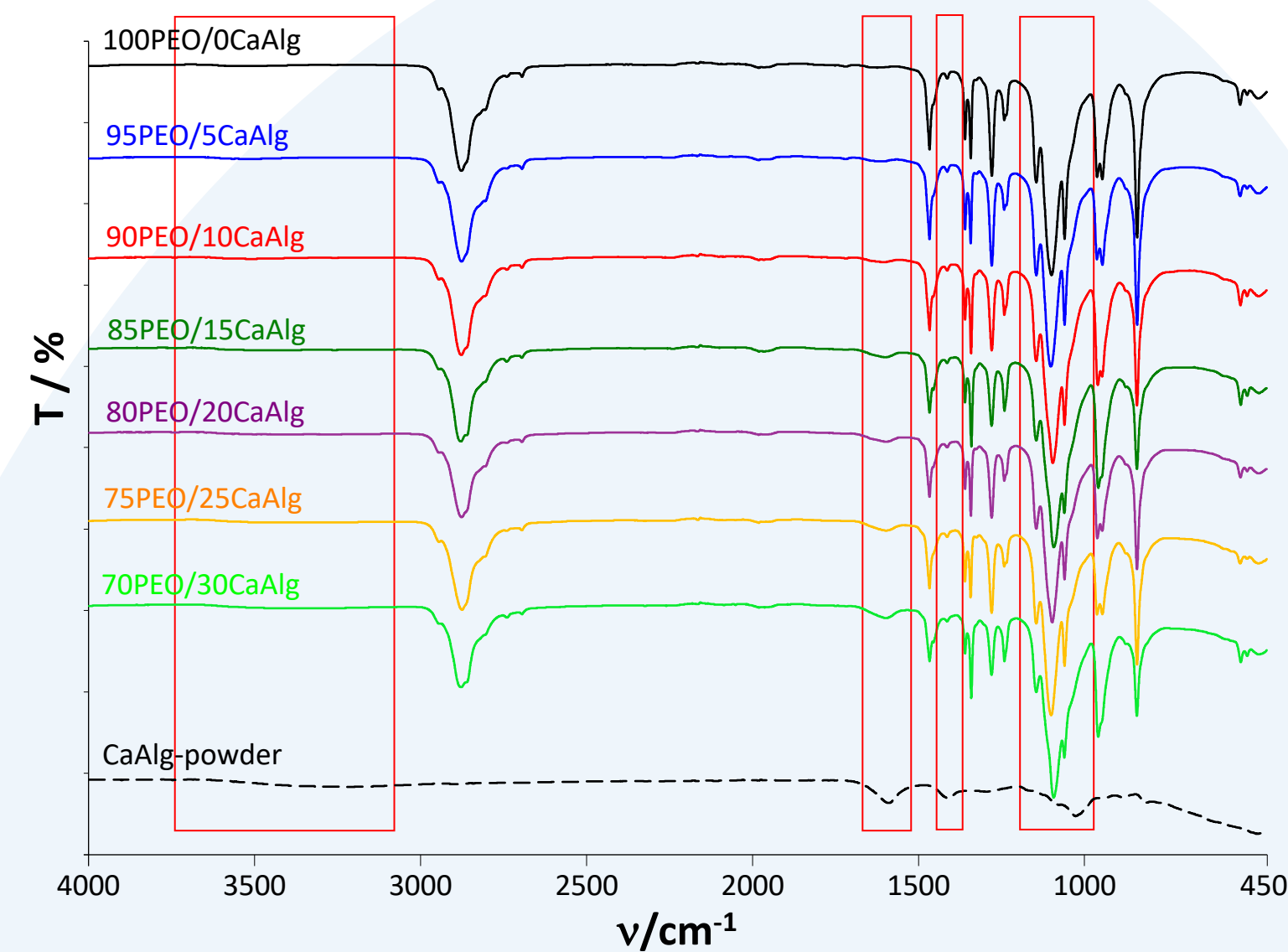


Figure 1. FTIR spectra of extruded PEO/CaAlg blends and CaAlg powder

Differential scanning calorimetry

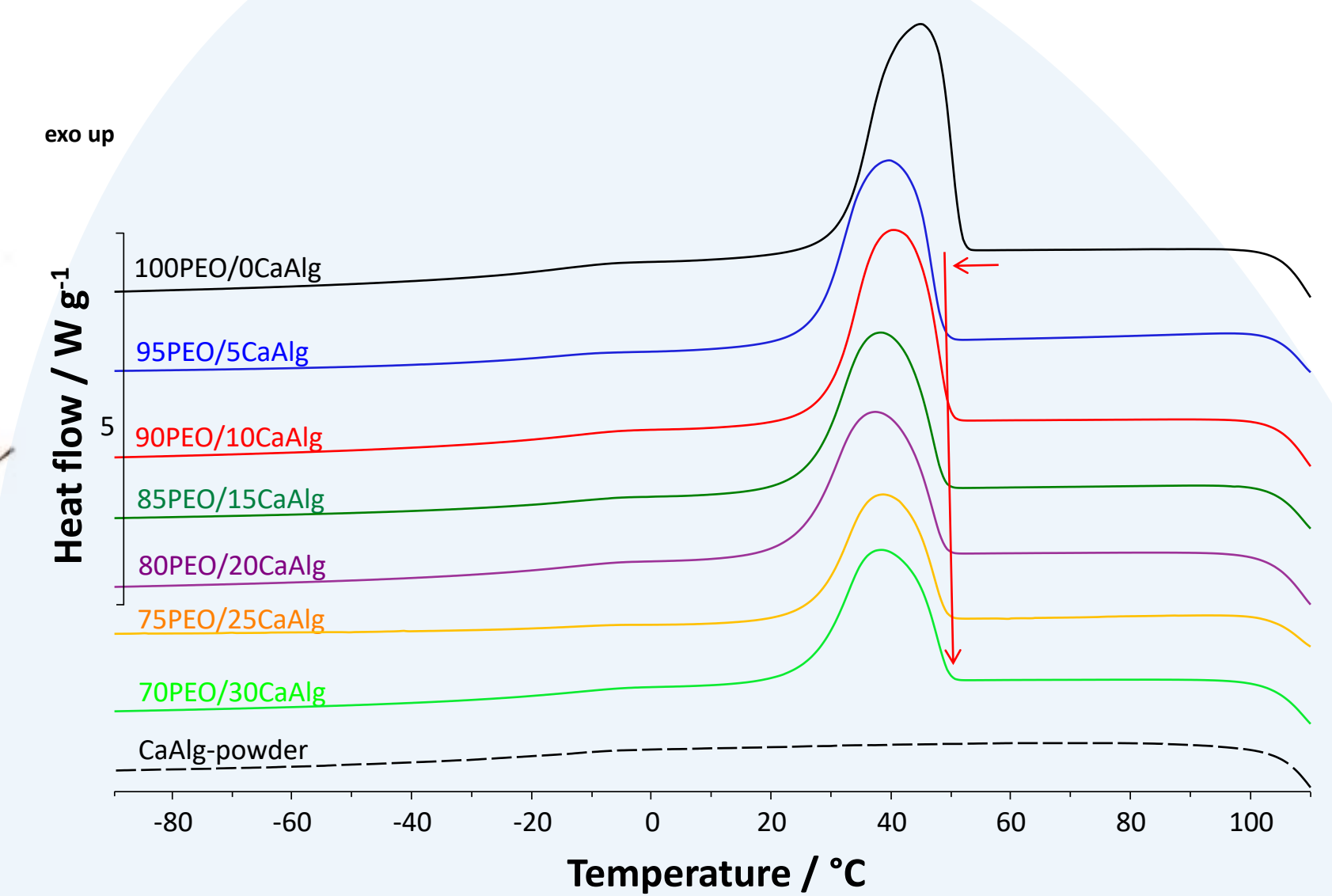


Figure 3. DSC curves of the cooling scan of extruded PEO/CaAlg blends and CaAlg powder

X-ray diffraction

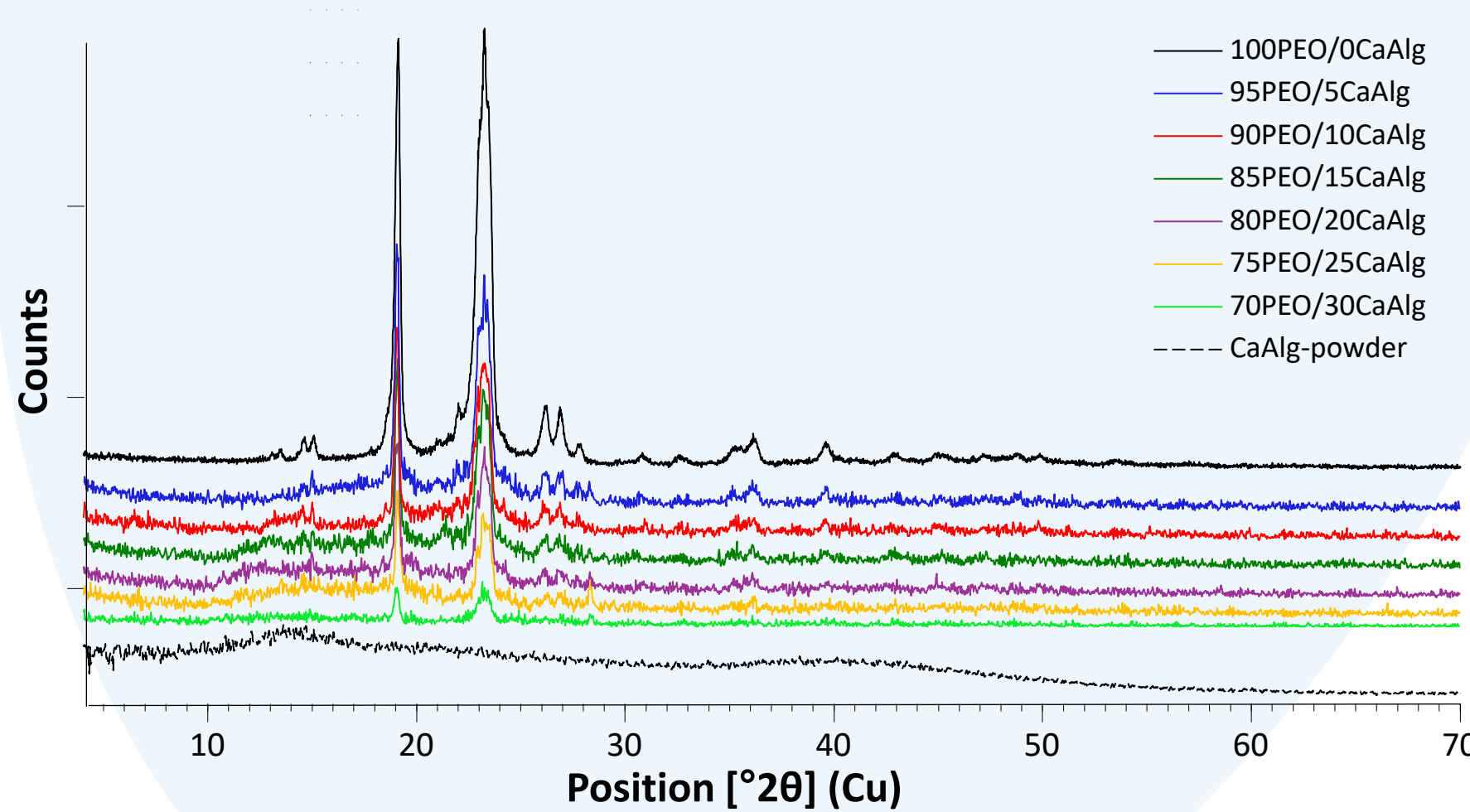


Figure 2. X-ray diffraction patterns of extruded PEO/CaAlg blends and CaAlg powder

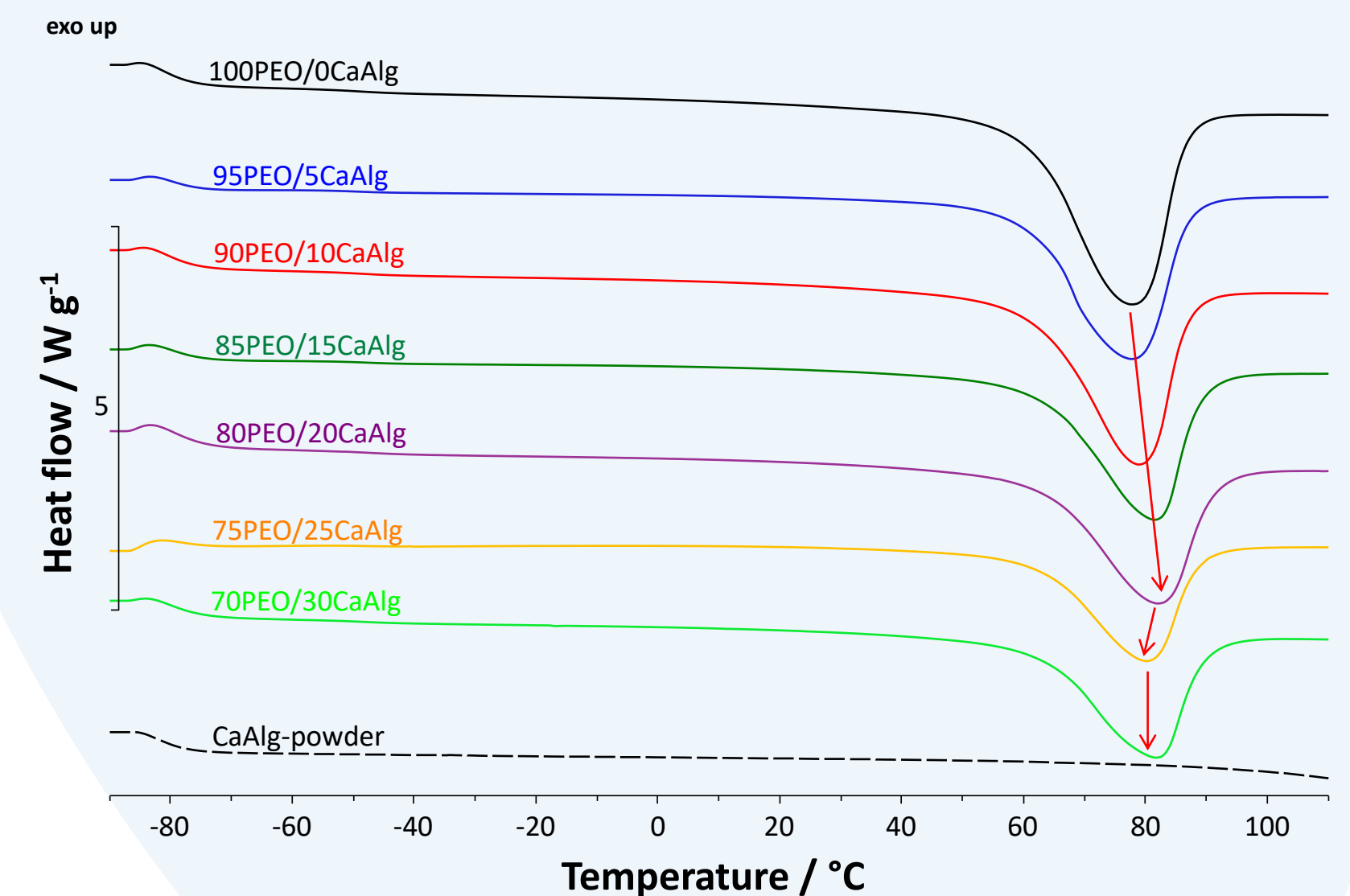
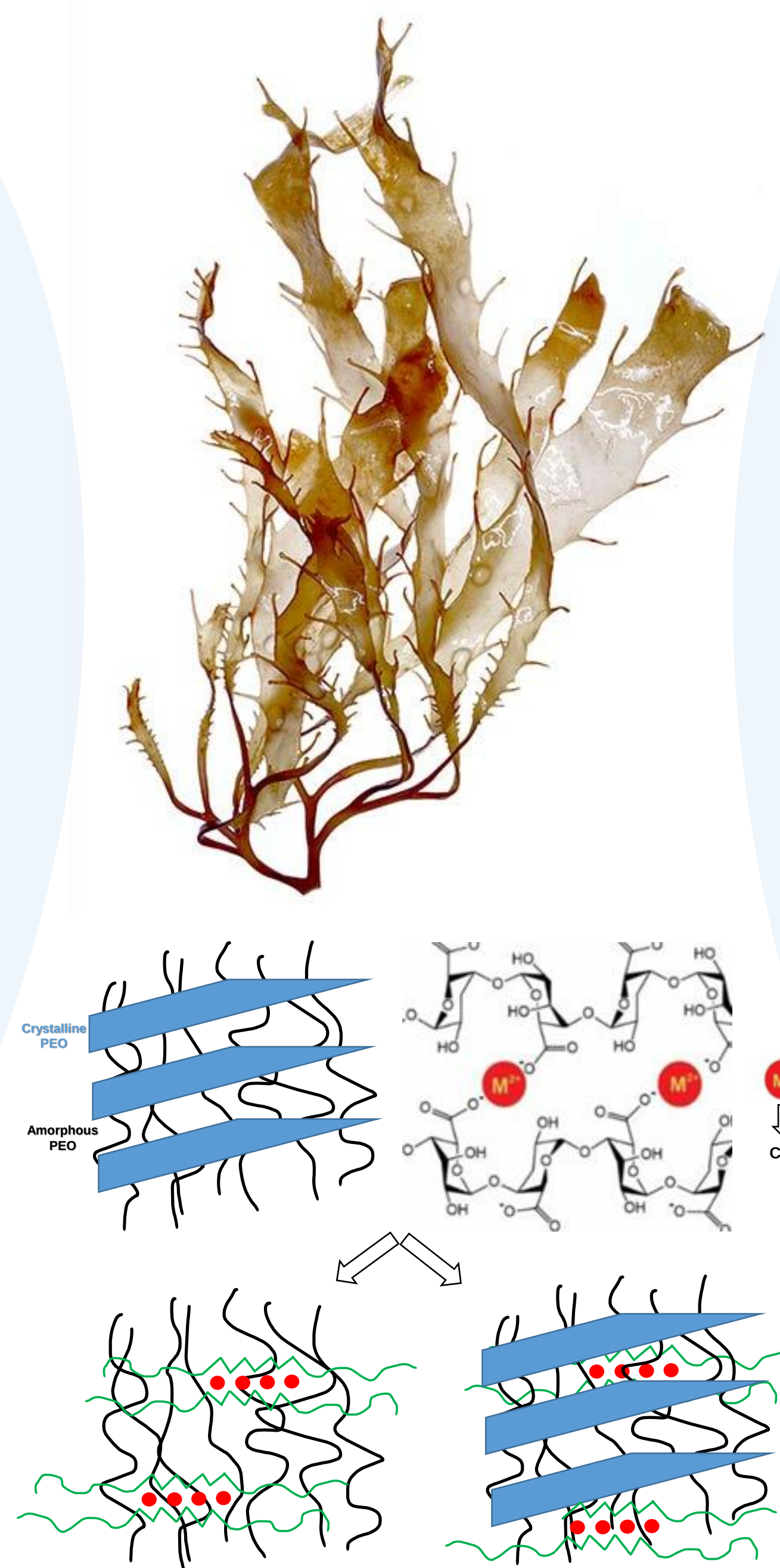


Figure 4. DSC curves of the second heating scan of extrude PEO/CaAlg blends and CaAlg powder

Thermogravimetry

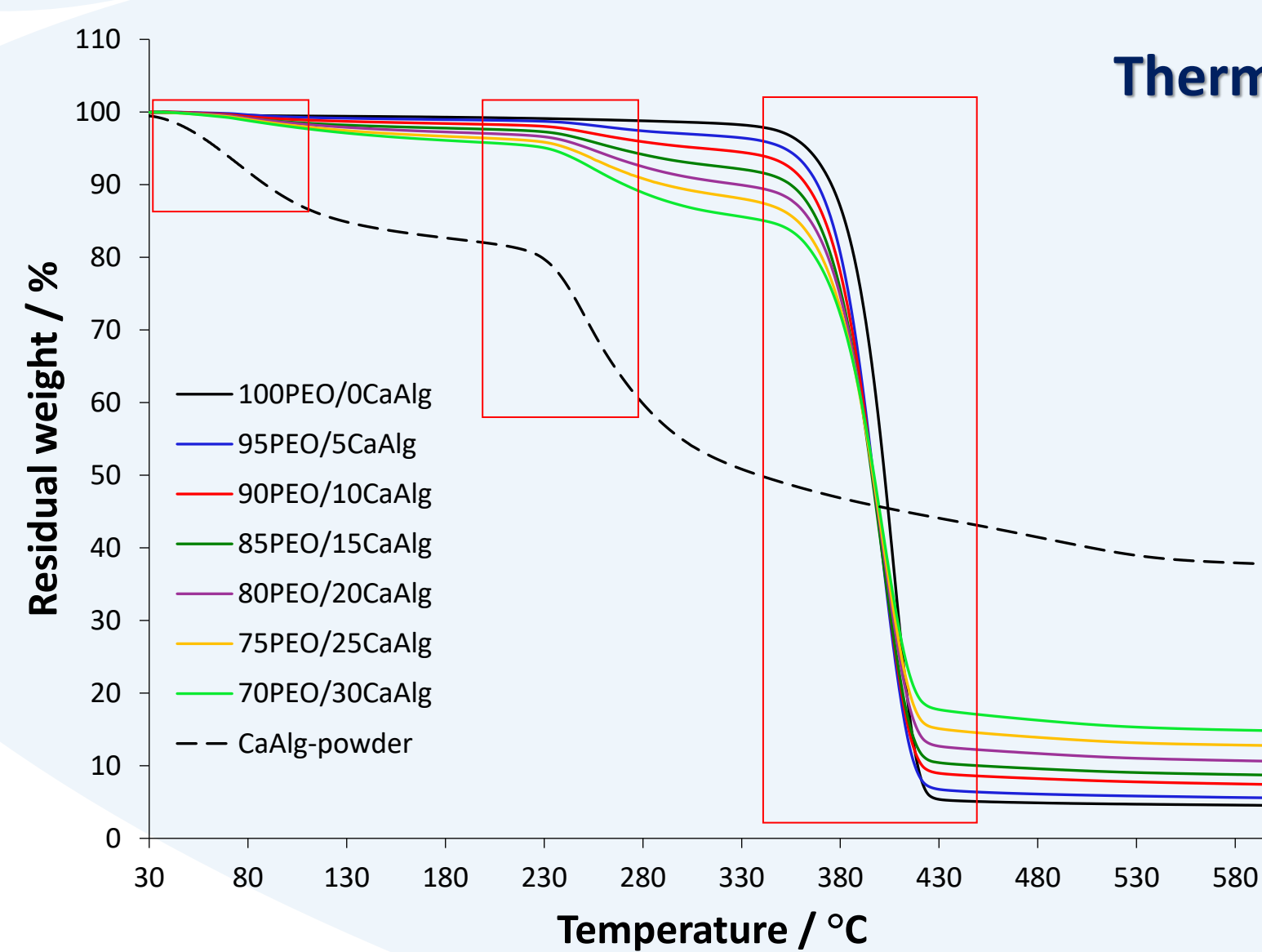


Figure 5. TG curves of the nonisothermal degradation of extruded PEO/CaAlg blends and CaAlg powder

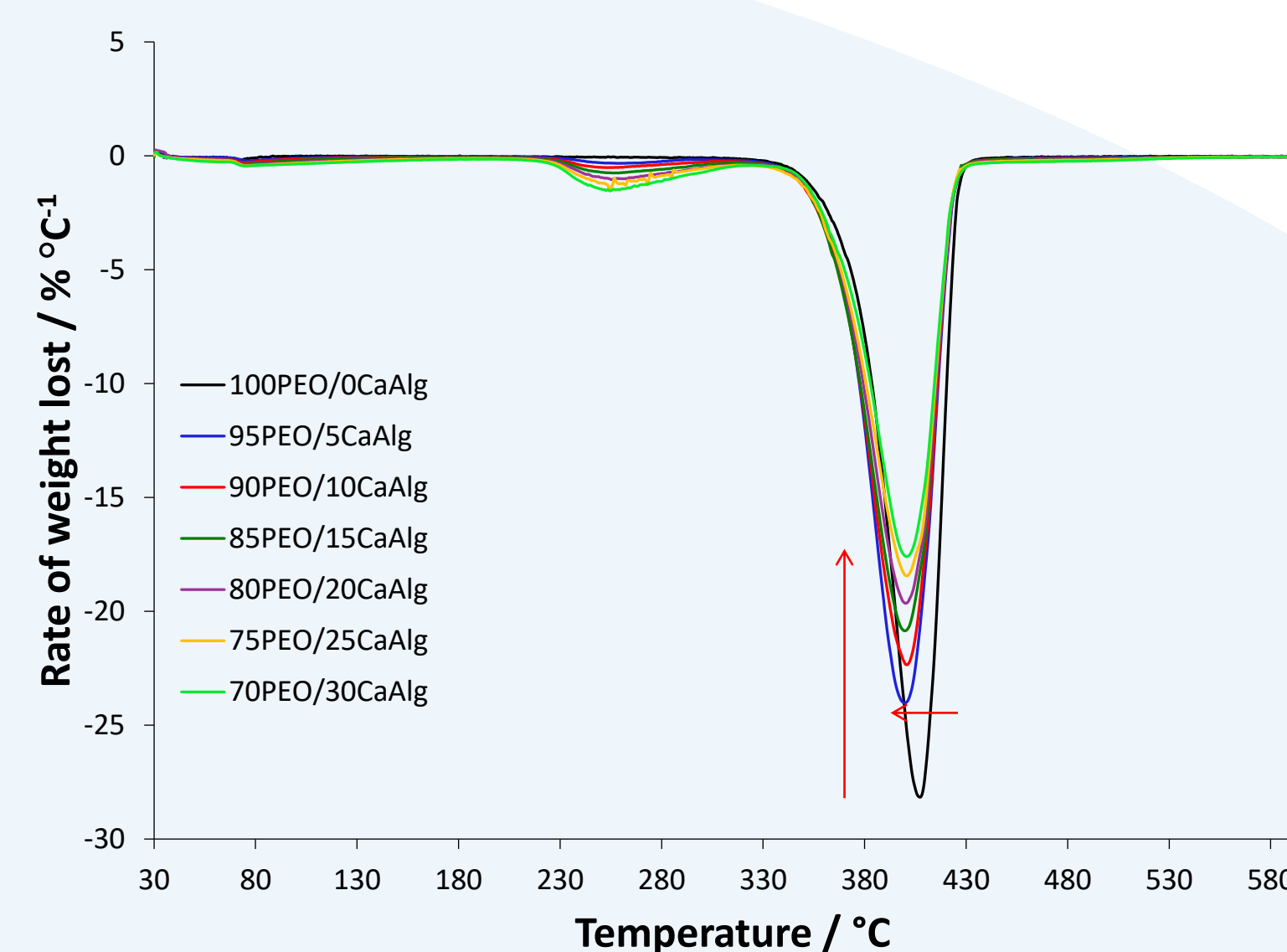


Figure 6. DTG curves of the nonisothermal degradation of extruded PEO/CaAlg blends and CaAlg powder

CONCLUSION: The samples were prepared by extrusion in twin-screw extruder that has circulation channel, so the homogeneity of materials as well as defined composition was achieved. Alginate didn't change crystalline structure of PEO even though it interacts with PEO through the hydrogen bond. Addition of CaAlg in PEO has the most pronounced influence on the crystallization from the melt. It postpones it, but as the content of alginate increases it doesn't change significantly. However, the degree of crystallinity remained high and in the range from 59 to 73%, too high for the desired purpose. PEO/CaAlg degrades in three degradation stages with a slight shift of PEO degradation stage to a lower temperature than pure PEO.