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We have used a combination of high resolution powder X-ray diffraction (HRPD), Raman spectroscopy, in situ powder diffraction and nitrogen adsorption measurements to study the effect on and nature of coke in the zeotype catalyst SAPO-34 during the methanol to olefin (MTO) and propene oligomerisation (PO) reactions. The coke caused by MTO leads to two distinct sets of HRPD peaks which can be indexed by two SAPO-34 unit cells with different lattice parameters and coke contents. We believe that these unit cells represent different zones of the catalyst filled with different coke types. PO coking does not lead to splitting of the diffraction peaks. Raman spectra show differences between the coke types produced by MTO and PO with the same overall trend of increasingly polyaromatic coke with increasing coke mass. The intensity of the monocyclic and polyaromatic peaks in the MTO Raman spectra correspond to the phase fractions of the two cell types used in the Rietveld refinement, suggesting a link between the two phases and the two coke types. The PO Raman spectra have a stronger polyaromatic band at low coke, suggesting that polyaromatics form faster. In situ powder XRD studies suggest that the C3 feeds do not penetrate the crystallites to the same extent as methanol as the zeolite cages fill with coke. This proposal is supported by nitrogen adsorption measurements.

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