Kinetics of Particle Growth for Supported Pt and Pt/Pd Determined Using HTXRD

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We have used High Temperature X-Ray Diffraction (HTXRD) to study the growth kinetics of platinum and platinum/palladium alloy particles supported on alumina in a wet, oxidizing atmosphere. Diffraction data were collected during isothermal aging exposures over time scales from 150 to 1.4×10^5 seconds and at temperatures from 773K to 1173K. The average precious metal particle size was determined from the diffraction peak widths, and the amount of crystalline material contributing to the peak was determined from the normalized peak area. Growth of crystalline particles was found to closely follow a power-law in time over the duration of the measurements, with the rate constant following an Arrhenius model for activation. The amount of crystalline material reached a maximum level determined by the aging temperature. Addition of palladium did not appear to limit the kinetics of crystallization, but did strongly suppress the maximum amount of crystalline material. Rescaling the exposure time using the measured Arrhenius behavior allows us to compare different time-temperature experiments and predict particle growth.