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C2Po2B-03: Uncertainty analysis of Raman spectra for measuring ortho-parahydrogen compositions

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Determining ortho-parahydrogen compositions at cryogenic temperatures is an important quality control for liquid hydrogen custody exchange. High orthohydrogen compositions lead to an exothermic reaction resulting in increased boil-off and increased venting losses of liquid hydrogen product by either the supplier or consumer. Traditional methods for measuring ortho-parahydrogen compositions such as hot-wire anemometry, nuclear magnetic resonance, and infrared spectroscopy are typically inconvenient at best. As the number of cryogenic hydrogen systems continue to increase, there is an increased need for flexible, standardized techniques for post processing composition measurements. A Raman spectrometer implemented in the Cryo-Catalysis Hydrogen Experimental Facility (CHEF) has demonstrated incredible flexibility for composition measurements of cryogenic hydrogen flows through a wide range of temperatures and pressures. This article analyses the uncertainty of Raman spectroscopy data of cryogenic hydrogen equilibrated at temperatures in IONEX catalyst. Spectra from hydrogen catalyzed to the equilibrium ortho-parahydrogen composition are processed and compared to expected statistical distributions for method verification.

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