Infrared Spectroscopy in Liquid Hydrogen Isotopologues for the ISS of ITER

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The ITER project aims at demonstrating the technical feasibility of nuclear fusion in a DT plasma. One of the important steps towards a functional fusion power plant is the development of a stable and reliable fuel cycle. Major developments on this field are made at the TRENTA experiments [1] located at the Tritium Laboratory Karlsruhe (TLK).
In this paper the design and installation of an analysis apparatus for tritium concentrations via InfraRed (IR) absorption for engagement in the Isotope Separation System (ISS) of ITER [2] is described. The IR analysis is performed in the liquid hydrogen phase at the bottom of a cryogenic distillation column similar to those foreseen for ITER ISS. Technical constraints and physical boundary conditions are presented as well as experimental methods and preliminary results.
The technical feasibility was proven and suggestions for further research and development on IR spectroscopy for ITER appliance are given. Over 120 resonances were detected and identified over a spectral range between 2,000 and 7,000 cm^{-1} in the first measurement run. Important steps towards identification of “best resonances” for composition analysis are taken. Special attention was paid to phonon resonances. The article also includes results of investigations on detection limit and dissolvability of resonances.

[1] CRISTESCU ET AL. “Commissioning of water detritiation and cryogenic distillation systems at TLK in view of ITER design” *Fusion Engin. and Design* **82,** 2126 (2007)
[2] GLUGLA ET AL. “The ITER tritium systems” *Fusion Engin. and Design* **82,** 472 (2007)