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C1Po1C-04: Efficiency improvement of small cryogenic helium turbo-expanders in TIPC

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An experimental helium liquefier/refrigerator, using ultra high speed cryogenic turbo-expanders is designed and developed in Technical Institute of Physics and Chemistry (TIPC), and liquefaction rate of around 42 L/hr and refrigeration capacity of around 130W@4.5K is achieved. The turbo-expander constitutes the most critical component of a helium liquefier/refrigerator causing that the turbine efficiency has a great influence on the performance of the whole cryogenic process plant. Inlet Flow Radial (IFR) turbine design is dictated by criteria like velocity ratios. For small flow rate plants the size of the turbine impeller needs to be reduced. In order to reach a high efficiency, the rotational speed must be increased to complete a large specific enthalpy drop. The present article describes the latest technical developments at TIPC, including results obtained during field trials with the TIPC helium liquefier and refrigerator. The motivation of these developments is to improve the efficiency of the machines, and also to widen the range of operation.

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