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Activated Carbon-Hydrogen based continuous sorption cooling in a single adsorbent bed with a LN2 heat sink

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The use of vibration-free solid-sorption based cooling in space cryogenics has a long successful history. In a typical Linde-Hampson cycle based liquefaction process, periodically
adsorbed (or desorbed) gas to (or from) a solid adsorbent plays the role of 'thermal compressor'. Alternatively, adsorbent beds can be used as 'condenser'or 'evaporator', while a mechanical compressor generates the required pressure swing. Unlike the heat-driven system where evaporation of the refrigerant produces cooling, in a 'mechanical compressor'driven system, cooling is generated by desorption of the gases from adsorbent. The second type of cooling process is rarely used in cryogenics is. Recently, a new concept has been proposed for creating a temperature difference between the two ends of a single adsorbent column with the quick and sequential inflow and outflow of adsorbate through the bed. This sorption cycle can be fundamentally differentiated from pulse tube operation in terms of their operating frequencies and the origin of cooling. In an empty pulse tube, the operating frequency is typically few Hertz. Conversely, the same in the new cycle is in the order of mili-Hertz. The cooling in a 'single bed'is due to the heat of desorption, whereas, the expansion of gaseous helium produces cryogenic refrigeration in a pulse tube. While, different adsorbent-adsorbate combinations are suitable for different temperature zones, theoretical investigations involving activated carbon-hydrogen have been made for generating refrigeration around liquid nitrogen boiling point.

Primary author: KOLEY, Susmita (Cryogenic Engineering Centre, IIT Kharagpur)

Co-author: INDRANIL, Ghosh (Cryogenic Engineering Centre, IIT Kharagpur)

Presenter: KOLEY, Susmita (Cryogenic Engineering Centre, IIT Kharagpur)

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