

Joule–Thomson Cryocooler

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- Cooling technology to create and maintain thermal environment below extremely low temperature (120 K, –153°C)
- Technology using expansion of gas compressed with several hundred atmospheric pressure to cool down to an extremely low temperature within a few seconds

Client / Market

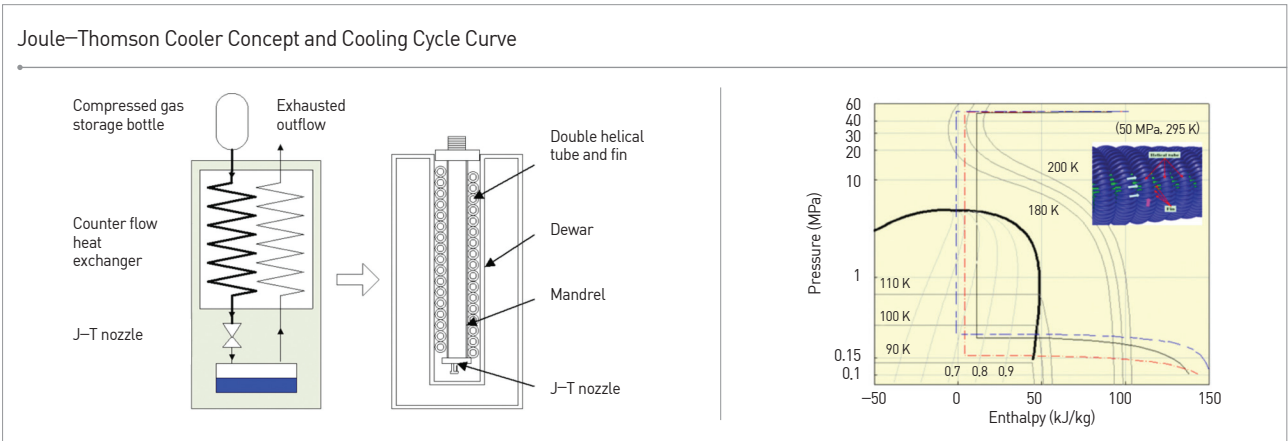
- Rapid cooling of infrared detector, small analytical instrument, cryosurgery, gas liquefaction

Necessity of this Technology

- Cryogenic cooling is crucial for a cooling type detector to achieve high resolution and clear image.
- For cryosurgery using extremely low temperature require safe and temperature–controlled cooling technology.
- Joule–Thomson cooling technology is a cooling technology that is smaller than other cryocoolers like Stirling cooler, pulse tube cooler, and GM cooler, can be operated under lower vibration level and enables rapid cooling.

Technical Differentiation

- Joule–Thomson cooling technology uses the cooling effect (Joule–Thomson effect) that occurs through sudden expansion of high–pressure gas that passes through a fine nozzle and amplifies the cooling effect through the high–efficiency heat exchanger to generate cryogen for cooling.
- In cooling of infrared detector, the Stirling or pulse tube cryocooler requires a few minute, but Joule–Thomson cooler uses a high flow rate of high pressure compressed gas to cool down to a cryogenic temperature in a few seconds. Its structure is relatively simpler and is easy to be miniaturized.



DESIRED PARTNERSHIP

Technology Transfer

Licensing

Joint Research

Other



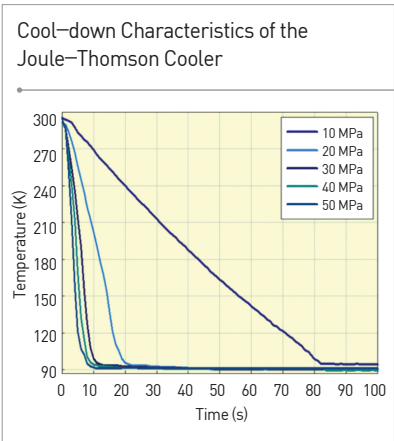
TECHNOLOGY READINESS LEVEL [TRL]

- Research, basic explanation
- Project concept or idea development
- Technology idea verification
- Prototype development
- Trial product production/evaluation in similar environment
- Pilot field demonstration
- Development and optimization of commercial model
- Commercial product demonstration
- Mass production and initial market launch

- A series of development process is needed for development of Joule–Thomson cooler including cooling cycle design, design and production technologies for components like heat exchanger, nozzle and flow control apparatus, and cooling function performance test.
- To secure sufficient cooling and long operating time while achieving rapid cooling, it is necessary to obtain optimal design technologies for small/high–efficiency heat exchanger, nozzle and flow control apparatus.
- For performance assessment of Joule–Thomson cooler, vacuum and cryogenic environment need to be established, and the thermal/structure design and operation technology of performance evaluation apparatus needs to be secured.

Excellence of Technology

- Equipped with technology for the entire development process for Joule–Thomson cooler–cooling cycle design, design of components (heat exchanger, nozzle, flow control apparatus), and cooling performance assessment (In–house design program for Joule–Thomson cooler design/cycle analysis/heat exchange and nozzle design program)
- Performance analysis technologies for Joule–Thomson cooler in steady and transient state
- Thermodynamic cycle analysis technologies for single (nitrogen, argon) and mixed refrigerant
- Completed verification of the technology through rapid cooling Joule–Thomson cooler development and performance test



Current Intellectual Property Right Status

PATENT

- Joule–Thomson Cooler Design (Program JTGUI: Registration No. 2011–01–123–005467, JTDESIGN2 : Registration No. 2011–01–123–005453)
- Joule–Thomson Cooler Cycle Analysis (Program JTR–CD (Joule Thomson Refrigerator–Cool Down) : Registration No. 08–01–121– 003011, JTC2ST : Registration No. 2010–01–121–004322)
- Nozzle, Flow Control Apparatus Design (Program NzFlow : Registration No. 2009–01–121–005649, TdBellows : Registration No. 2011–01–123–004743)
- Joule–Thomson Cooler Thermal Load Analysis (Program ColdFinger : Registration No. 2009–01–121–001780)

KNOW–HOW

- Joule–Thomson cooler’s cooling performance assessment technology