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# C1Po2B-03: Development of non-flammable mixed refrigerant Joule-Thomson refrigerator for semiconductor etching process

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A cryogenic mixed refrigerant Joule-Thomson refrigerator was developed to apply the cryogenic etching process with non-flammable constituents. 2-stage cascade type mixed refrigerant Joule-Thomson refrigerator was analyzed to figure out the coefficient of performance of the refrigeration cycle. The working fluid of mixed refrigerant Joule-Thomson refrigerator is non-flammable mixture of argon(Ar), tetrafluoromethane(R14), trifluoromethane (R23) and octafluoropropane(R218). The designed refrigeration cycle was adapted to cool down the coolant of HFE7200 (Ethoxy-nonafluorobutane, C4F9OC2H5) with the target temperature of -100℃. Cooling capacity of 2 kW was obtained at the heat exchanger of the coolant side. The detailed experimental results of the mixed refrigerant Joule-Thomson refrigerator were discussed in this study.

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