Cryogenics for a time-of-flight mass spectrometer with superconducting particle detectors

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Superconducting detectors are promissing for mass spectrometers, which are important in proteomics, since the superconducting detectors have 100% detection efficiency for a wide mass range from atoms to proteins. The high detection efficiency relies on a very small threshold to detect quantum energies. However, the smallness of effective detection area and the requirement for a low temperature of 0.3 K (-272.85 °C) are bottlenecks. We succeeded in realizing the implementation of cryogenic wiring between a large scale superconducting array detector, which is on a cold stage of 0.3 K, and electronics at room temperature.

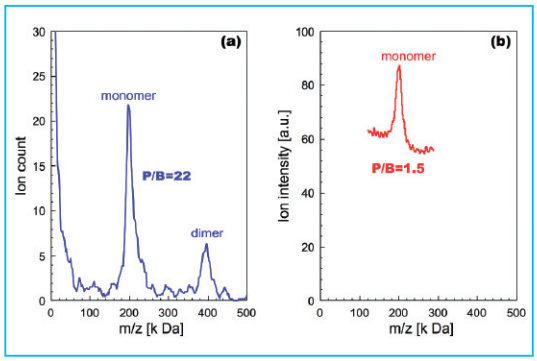

Figure 1: Comparison of detection efficiency for a very large macromolecule oaf polystyrene between a superconducting detector (a) and a conventional microchannel plate detector (b).

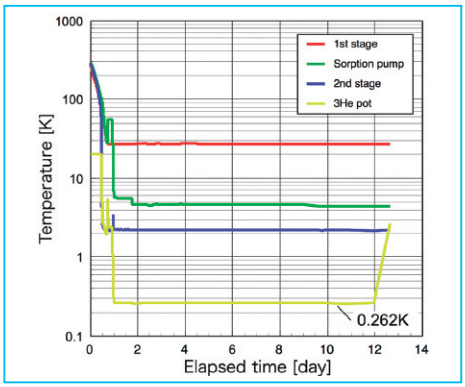

Figure 2: Cooling curves of a cryogen-free cryostat equipped with one hundred coaxial cables.

Development of highly-integrated plastic biochips; Open the doorway to low-cost and desk-side medical diagnosis

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Replica biochips for capillary array electrophoresis with 10 separation channels (50 µm width, 50 µm depth and 100 µm pitch) were successfully fabricated on a poly(methyl methacrylate) (PMMA) substrate using injection molding technique. The current fabrication method used moving mask deep X-ray lithography to fabricate an array of channels with inclined channel sidewalls. A slight inclination of channel sidewalls is highly required to ensure the release of replicated biochips from a mold. Moreover, the sealing of molded PMMA multichannel chips with a PMMA cover film was achieved using a novel bonding technique involving adhesive printing.

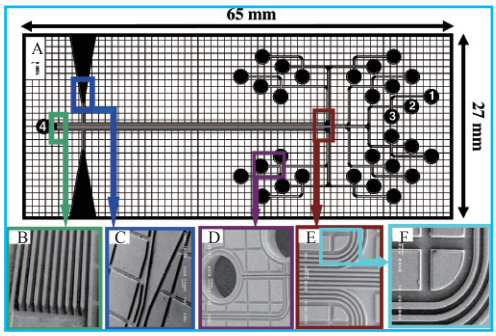

Figure 1: Schematic of a 10-channel PMMA biochip for microchannel electrophoresis. (A) Design of a biochip with 10 separation channels of 50 µm in width and 50 µm in depth. (B) –(F) close-up views of a biochip using scanning electron microscope.

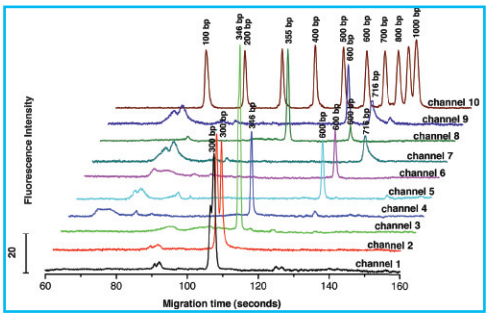

Figure 2: Electropherograms of PCR products of a control gene (channel 1 and 2), surfactant protein (SP) genes (channel 3 to 9) which are related with human lung cancer, and a 100-bp DNA ladder (channel 10) on a 10-channel bio chip. Appearance of a control gene in channel 1 and 2 shows that the procedure is valid for all the sample preparations.