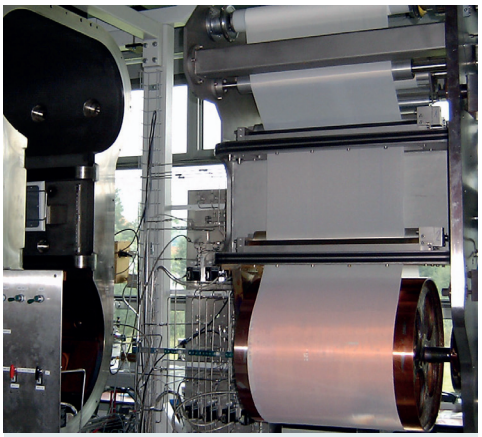
Water-repellent fabrics and textiles

Application note A078-ST99-0517B

◆ Water-repellent raincoat

Waterproof yet breathable clothing prevents rainwater drops from penetrating, and at the same time allows perspiration vapour to pass - very desirable when exercising in the rain. And stain-repellent fabrics protect your clothes against coffee, juice or food stains. In both cases, a hydrophobic coating is responsible for the anti-wetting behaviour. How can you make fabrics and textiles hydrophobic or add other functionalities to them without affecting the bulk properties of their fibers?

Empa, part of the Swiss technology institute ETH and devoted to materials research, investigates and applies plasma polymerisation to deposit thin, nanoscale layers on top of fabrics and fibers, in order to functionalise their surface - and more specific: to make them water-repellent. Bronkhorst devices play an important role in this process, especially in the controlled supply of polymer precursors.



Web coater at Empa, St. Gallen

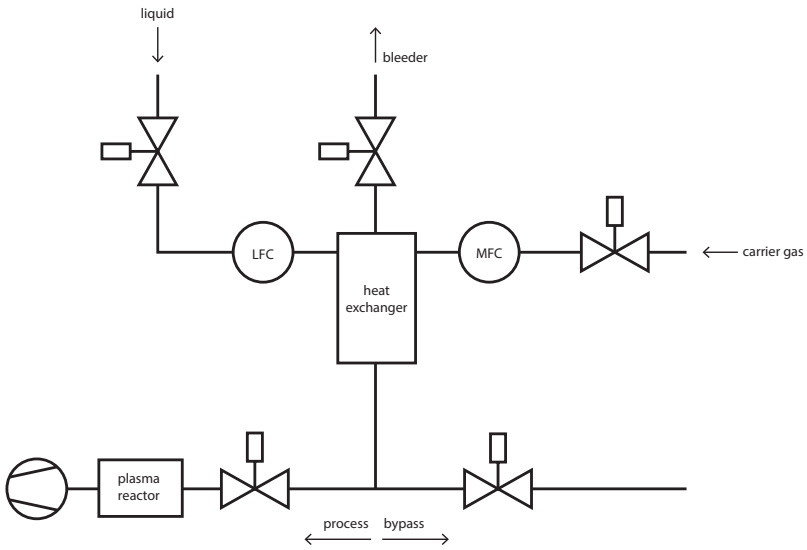
Application requirements

In the low-pressure (0,1 mbar) plasma polymerisation process at Empa, the liquid silicon-organic compound hexamethyldisiloxane (HMDSO) is evaporated and successively activated by the plasma with the aim to be polymerised and deposited onto the fiber surface as a hydrophobic coating.

In order to obtain a stable and reproducible polymer precursor vapour flow, the liquid HMDSO flow as well as a carrier gas flow have to be controlled accurately. The HMDSO vapour is introduced into the plasma chamber at defined flow rates, where high rates promote high deposition rates and fast processing.

Important topics
- ◆ Accurately controlled gas/liquid mixture
- ◆ Stable vapour flow
- ◆ Low to high vapour flow rates

Process solution



Flow scheme

The Bronkhorst CEM (Controlled Evaporation Mixing) system is used to evaporate silicon-organic HMDSO. In this setup, liquid HMDSO is drawn from a container at room temperature and measured by a mini CORI-FLOW mass flow meter. Then the liquid HMDSO is mixed with argon carrier gas from an EL-FLOW thermal mass flow controller and vaporised inside a heat exchanger for controlled heating. The vapour flow is introduced into the plasma reaction chamber operated at 0,1 mbar absolute pressure. A PLC system controls the entire evaporation process.

Using this setup, HMDSO is evaporated in a wide range of 1 to 30 grams per hour. First results show that vapour flows are generated in a stable, accurate, repeatable and well-controlled way. LabView software is used to visualise the evaporation process simply and effectively.The currently used CEM system has replaced a traditional and time-consuming bubbler system with a limited low flow rate of carrier gas and precursor. Using the CEM system, Empa obtains a higher yield of 50 ml/min of gas, whereas in the earlier bubbler system only 4-5 ml/min of gas was possible. Likewise the HMDSO liquid flow has been increased. Empa's aim for the near future is to upscale the process, from laboratory scale to industrial scale.

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Bronkhorst®

The currently used CEM system at Empa is mobile. This compact setup on wheels has the size of a small office table, which makes it possible to move the system from one laboratory to the other rather easy. The compactness of Bronkhorst devices is an additional advantage here. HMDSO allows the deposition of polysiloxane coatings at low temperature, which makes it feasible to coat textile fibres that cannot withstand high temperatures. Empa's attempts to conduct the plasma polymerisation at low pressure aim at increasing the production yield by promoting heterogeneous deposition on the fiber's surface, and by reducing the amount of chemicals. ■

CEM System

Recommended Products

EL-FLOW Select

EL-FLOW Select Series Mass Flow Meters/Controllers are thermal mass flow meters of modular construction with a 'laboratory style' pc-board housing. Control valves can either be integrally or separately mounted, to measure and control gas flows from lowest range 0,014...0,7 mln/min up to highest range 8...1670 ln/min.

- High accuracy (standard 0,5% RD plus 0,1% FS)
- Rangeability in digital mode up to 1:187,5
- Fast response (down to 500 msec)
- Excellent repeatability
- Optional multi-gas/-range functionality
- Pressure ratings 64/100 bar
- Analog I/O-signals, RS232-connection
- Compact, modular construction

mini CORI-FLOW M12

The unique design of the miniature Coriolis sensor features unsurpassed performance, even with changing operating conditions in pressure, temperature, density, conductivity and viscosity. Contrary to many other Coriolis flow meters on the market, mini CORI-FLOW offers integrated PID control and close-coupled control valves or pumps.

- Direct mass flow measurement
- High accuracy, excellent repeatability
- Cost-effective design
- Compact design, with integrated PID controller for fast and stable control
- Suitable for (very) low flow ranges
- Digital technology allows fieldbus communication and offers configurable control characteristics

CEM (Controlled Evaporation Mixer)

The CEM-System can be applied for atmospheric or vacuum processes. The system consists of a (thermal or Coriolis) liquid flow controller, an MFC for carrier gas and a temperature controlled mixing and evaporation device. The system is suitable for mixing liquid flows of 0,25-1200 g/h resulting in saturated vapor flows of 50 ml_n/min up to 100 l_n/min.

- Accurately controlled gas/liquid mixture
- Fast response
- High reproducibility
- Handles water, solvents, liquid mixtures
- Very stable vapor flow
- Flexible selection of gas/liquid ratio
- Lower working temperature then conventional system

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ST: Surface Treatment
99: Miscellaneous