KIM Laboratory

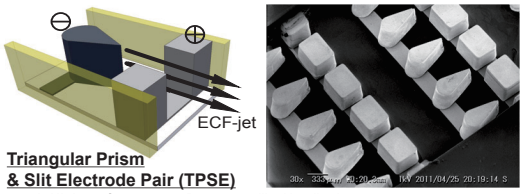
High power density micropump and its applications

Industrial Mechano-System Research Core,
Lab. for Future Interdisciplinary Research of Science & Technology (FIRST)

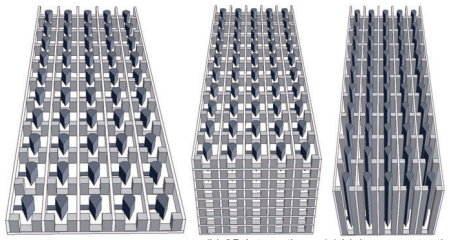
http://www.smart.first.iir.titech.ac.jp

- Micro hydraulic power sources by ECF jet
- Pressure source-mounted soft actuators
- MEMS-based ECF micro rate gyroscopes
- Liquid cooling systems by ECF micropumps

We focus on micromechatronics researches by utilizing the ECF (electro-conjugate fluid) effect.
By combining MEMS fabrication and ECF jet flow generated by the applied voltage, we realize micro hydraulic power sources (ECF micropumps) having the world's top high output power density.
By installing the ECF micropumps inside, we develop various microactuators and microsensors such as ECF soft robots and ECF rate gyroscopes.



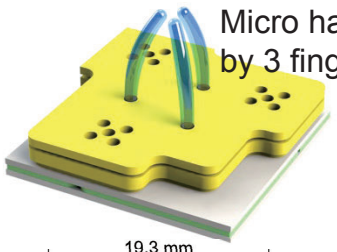
Triangular Prism & Slit Electrode Pair (TPSE)
1. **High performance:** 3D structure like Needle-ring
2. **Photolithography forming:** Column-like structure

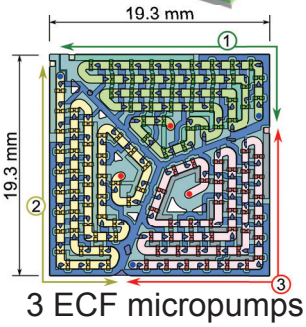


How to realize high power density ECF micropumps

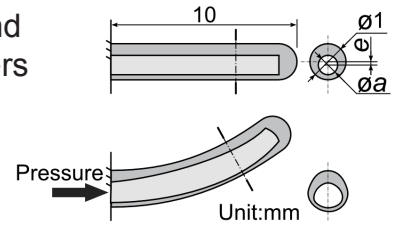
High power density of ECF micropumps by the integration of TPSEs

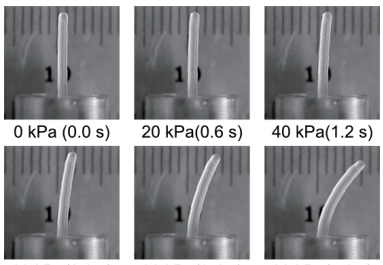
- Simple structure without mechanical sliding parts.
- Output pressure increased by the TPSE serialization.
- Output flow rate increased by the TPSE parallelization.





3 ECF micropumps

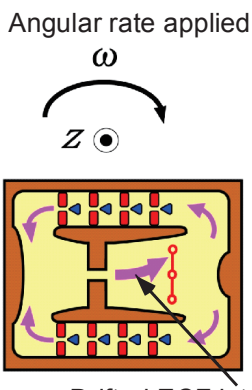




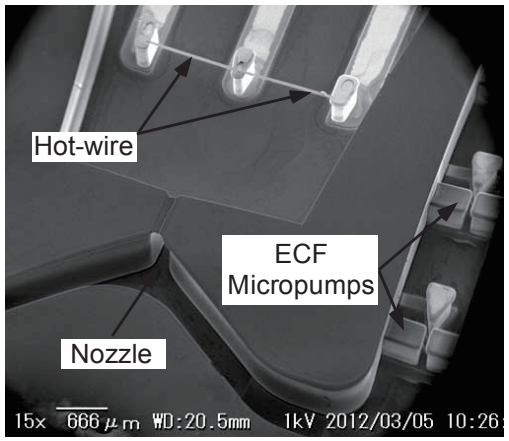
Finger motions

Soft robot equipped with pressure source

- To drive soft actuators by the pressure of the ECF jet.
- To achieve both (a) high output force and (b) large displacement by using the unibody of an eccentric tube.
- To realize a pressure source-mounted microhand by using three ECF microfingers of the eccentric tube.



(a) Working principle



(b) MEMS-fabricated ECF micro rate gyroscope

Micro rate gyroscope by ECF jet

- To detect the ECF jet deflected by Coriolis force by using hot wires of the Wheatstone bridge circuit.
- Excellent shock resistance due to no mechanical moving parts.