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Expandable and retractable self-rolled structures based on metal/polymer thin film for flow sensing[1] JIANZHONG ZHU, CARL WHITE, MEHDI SAADAT, HILARY BART-SMITH, University of Virginia — Most aquatic animals such as fish rely heavily on their ability of detect and respond to ambient flows in order to explore and inhabit various habitats or survive predator-prey encounters. Fish utilize neuromasts in their skin surface and lateral lines in their bodies to align themselves while swimming upstream for migration, avoid obstacles, reduce locomotion cost, and detect flow variations caused by potential predators. In this study, a thin film MEMS sensor analogous to a fish neuromast has been designed for flow sensing. Residual stress arises in many thin film materials during processing. Metal and polymer thin film materials with a significant difference in elastic modular were chosen to form a multiple-layer structure. Upon releasing, the structure rolls into a tube due to mechanical property mismatch. The self-rolled tube can expand or retract, depending on the existence of external force such as flow. An embedded strain sensor detects the deformation of the tube and hence senses the ambient flow. Numerical simulations were conducted to optimize the structural design. Experiments were performed in a flow tank to quantify the performance of the sensor.

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