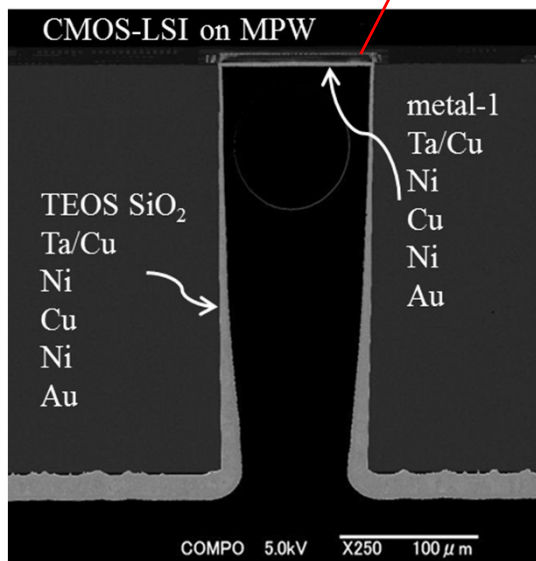


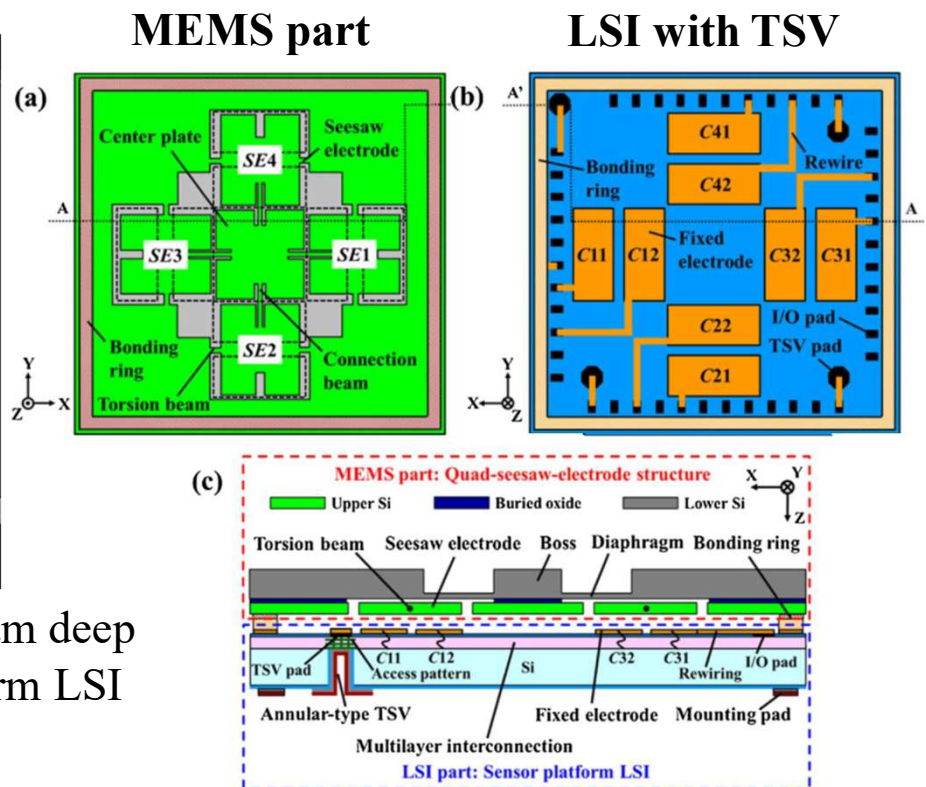
(a) **MEMS part**

LSI with TSV

(b)



No Cu filling TSV is 300- μ m deep
in an original sensor platform LSI



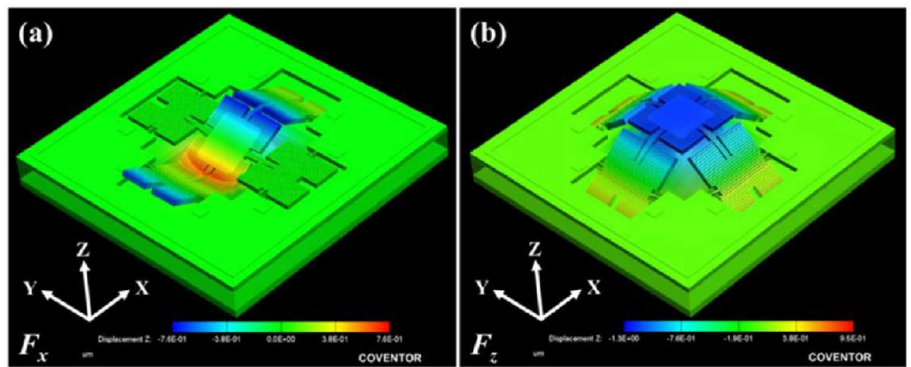
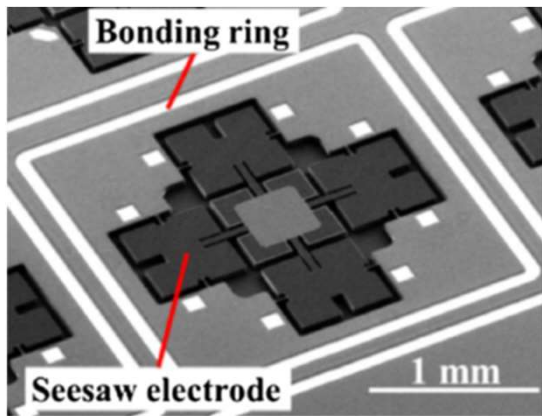
wafer level integrating MEMS and LSI

MEMS-on-LSI integrated tactile sensor that has both fully differential capacitive 3-axis force sensing and signal processing. The MEMS part is composed of a quad-seesaw-electrode structure for fully differential capacitive detection. The LSI part is an original sensor platform LSI(TSMC0.13) that enables signal processing and serial bus communication. The sensor platform LSI was processed for the MEMS-on-LSI integration, the additional processing formed 300- μm -deep annular TSVs, a bonding ring, and sensor electrodes. By Au-Au thermocompression bonding of the fabricated MEMS and LSI parts, a 2.8-mm-square surface-mountable MEMS-on-LSI integrated tactile sensor was completed.

“Tohoku TSV CMOS-MEMS platform” gives many chance for development of surface-mountable CMOS-integrated MEMS.

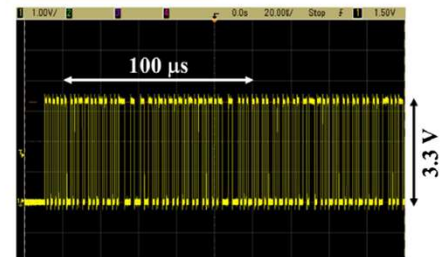
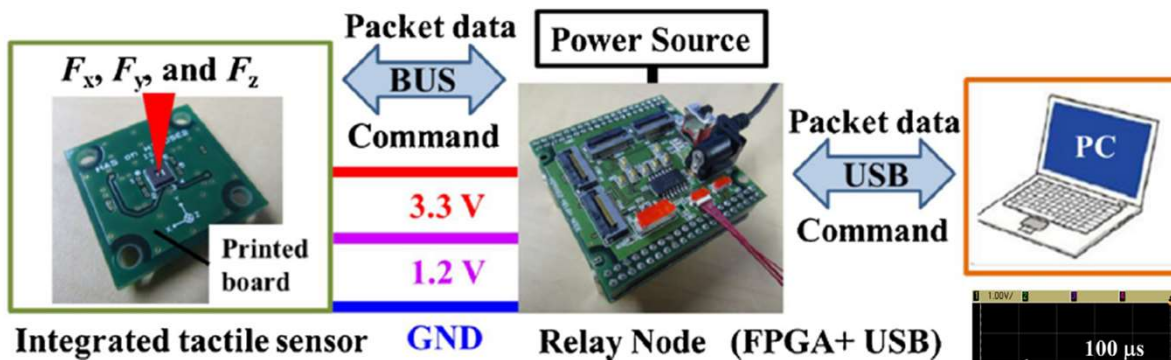
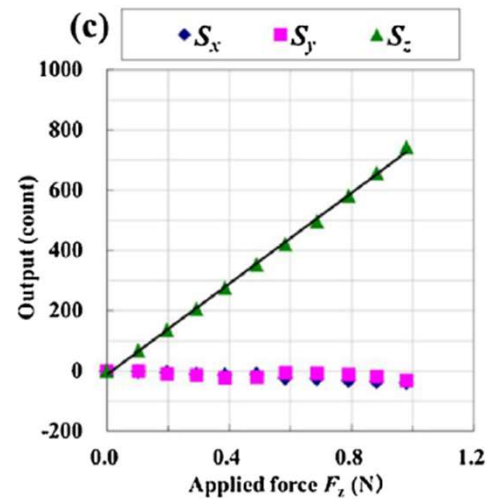
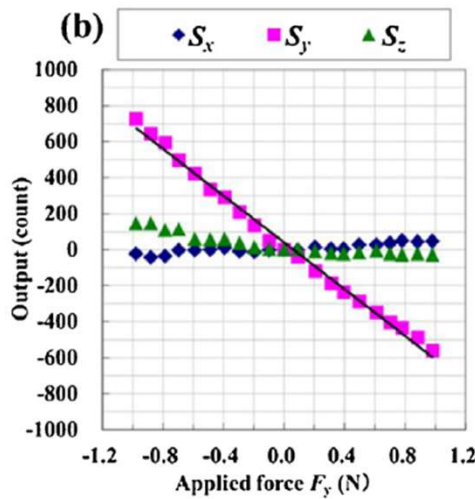
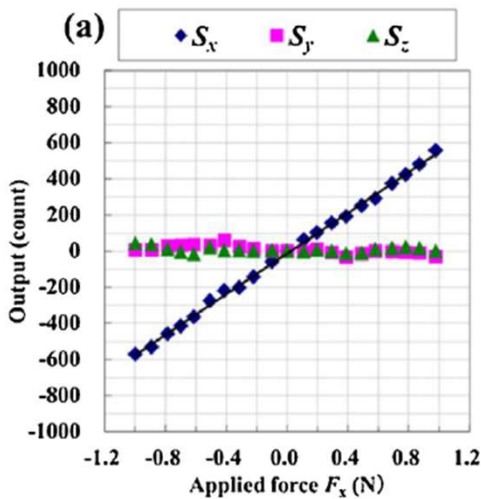


MEMS part



(a) shear force X, Y

(b) normal force Z



A working test demonstrated that digital packet transmission through TSV and confirmed the working principle of 3-axis force sensing with fully differential capacitive detection. A **fully integrated and fully differential 3-axis tactile sensor** was achieved on a single chip with “Tohoku TSV CMOS-MEMS platform” .

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Tohoku University Micro System Integration Center (http://www.mu-sic.tohoku.ac.jp/index_e.html)
519-1176 Aramaki-Aza-Aoba, Aoba-ku, Sendai 980-0845

Phone : +81-22-229-4113 Fax : +81-22-229-4116 e-mail: micro-shien @ grp.tohoku.ac.jp