Three weeks at CNST of NIST

Pavel Neuzil & Vojtěch Svatoš,
Centre SIX, Faculty of Electrical Engineering and Communications, Brno University of Technology, Technická 10, 616 00 Brno, Czech Republic
pavel.neuzil@gmail.com

We have a project to develop high efficiency micromachined bolometers for infrared imaging. The process consists of 5 lithographic levels with relatively demanding alignment tolerance between levels, thereby requiring the overlay accuracy of the Center for Nanoscale Science and Technology (CNST) NanoFab stepper. We spent a total of 5 weeks at the National Institute of Standards and Technology (NIST in Gaithersburg, MD) during our two visits, one in December 2014 and one in February 2015. First visit was more introductory, while the second one was extremely productive. During the second visit, devices for several projects, including micromachined bolometers, were fabricated and are currently undergoing testing.

Bolometer fabrication consisted of many process steps including, 2 PECVD SiO_2 depositions, sputtering of Aluminum and Titanium layers, zero level lithography for alignment marks and subsequent 5 device-layer lithography levels, reactive ion etching of Si, Al, Ti and SiO_2, metal thin film lift-off and finally a XeF_2 silicon etch release. The entire process (with the exception of the liftoff and XeF2 release) was performed at CNST. The fabricated device is shown in Fig. 1.

We scheduled three weeks for the completion of our major goal, the bolometer fabrication sequence. Because the bolometer fabrication process was completed earlier than expected, we decided to use the remaining time to fabricate a few other devices, including two types of electrochemical sensors, a chip for the polymerase chain reaction (PCR) and nanostructured materials for gecko mimicking structures. We fully finished one of the electrochemical sensor (Fig. 2) and mold for gecko mimicking structure (Fig. 3). The second electrochemical chip as well as the PCR device each require only a few more steps for completion. We plan to accomplish these tasks during the summer of 2015.

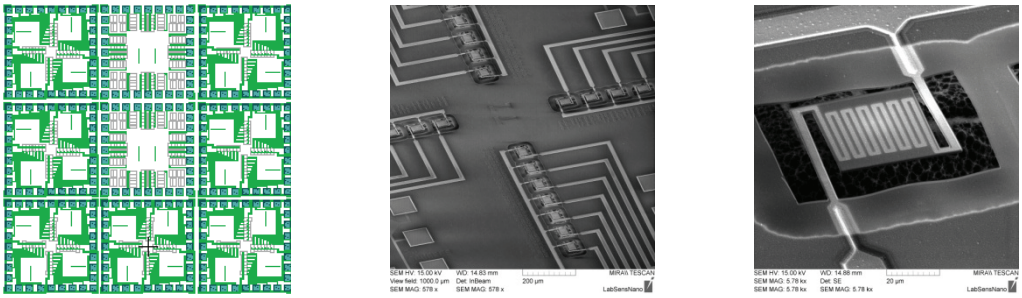

Figure 1 Layout of a 9mm x 9mm bolometer chip (left). The chip contains several device architectures for testing various fundamental parameters. SEM of the central device region (middle) and a released bolometer device (right)

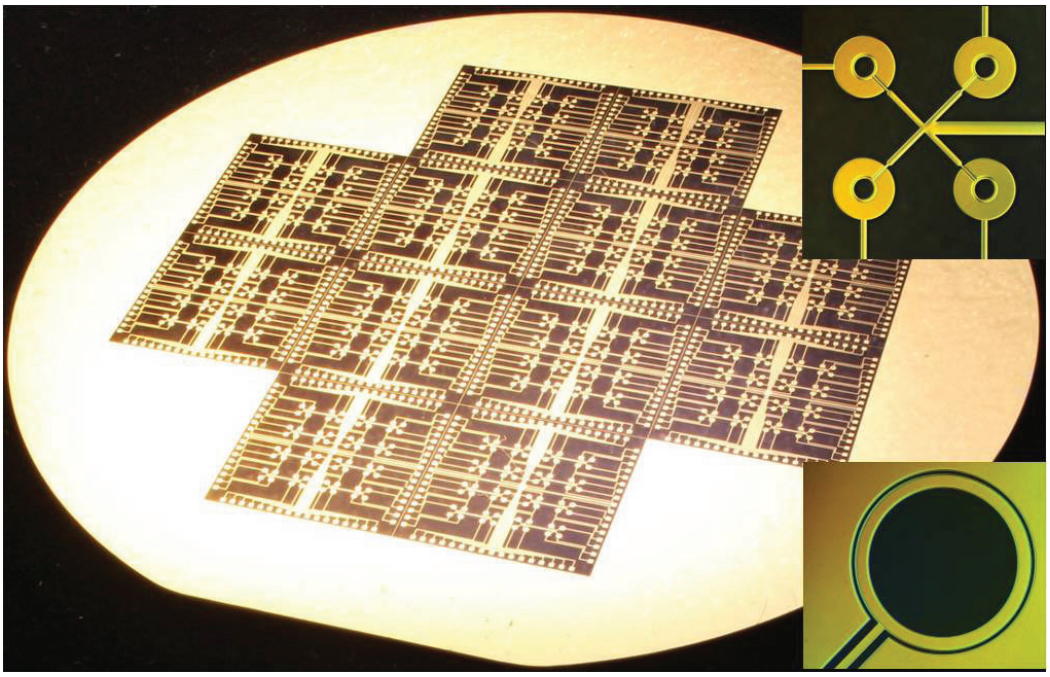

Figure 2 Fabricated array of electrochemical sensors. Each array consists of 4 x 4 sets of four units of two electrode systems, working and pseoudoreference electrode. The system is compatible with lock-in based electronics read-out system we have developed earlier. We can measure 4 electrode sets simultaneously. Each pseudoreference electrode is powered with pulses of a unique frequency and the collected composite current from all he working electrodes is then demultiplexed. The working electrode area of 8500 μm^2 and the pseudoreference electrode is 19 x larger. The cyclic voltamogram has shape of a sigmoidal function, typical for microelectrodes.

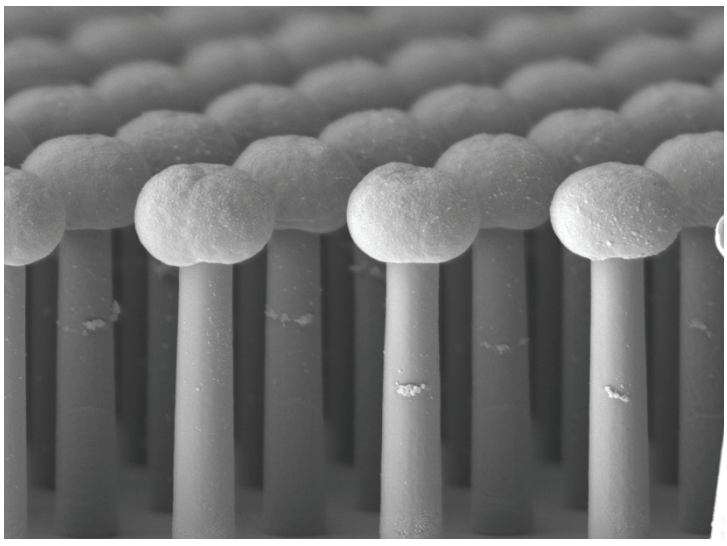

Figure 3 Expected shape of the structures using mold fabricated at CNST.