

Idaho Incubation Fund Program

Progress Report Form

Proposal No. IF14-005

Name: Peter Mullner

Name of Institution: Boise State University

Project Title: Integral 3-D strain sensor

Reporting Period: July 1- December 31, 2013

Information to be reported in your progress report is as follows (attach additional information as needed):

1. Summary of project accomplishments for the period just completed and plans for the coming reporting period:
 - a) *Activities for identifying industry partners:* We organized a business development event at the 4th International Conference on Ferromagnetic Shape Memory Alloys. Following this event, we initiated an international network “MSM-Net” for connecting researchers and industrial developers and bringing our technology to the market. The kick-off meeting of MSM-Net is scheduled for the ACTUATOR 2014 conference June 23-25, 2014, in Bremen, Germany.
 - b) *Research activities:* We produced Ni-Mn-Ga single crystal powders by crushing single crystals and annealing the powders. With X-ray diffraction, we demonstrated the desired crystallographic structure. With magnetization experiments, we demonstrated successfully a low switching field of 200 mT, which is clearly below the specified upper limit of 300 mT ensuring high twin mobility. We identified and purchased elastomer matrix material, produced Ni-Mn-Ga/elastomer composites, and performed preliminary mechanical experiments. We made double-coils for 1-D sensor tests and measured the strain-induced change of coil inductance at a single crystal.
 - c) *Plans for coming reporting period:* We will produce Ni-Mn-Ga/elastomer composites with various powder volume fraction and stiffness. We will characterize twin mobility via mechanical and magnetic testing. Upon successful demonstration of twinning, we will assemble a 1-D strain sensor with one double-coil and demonstrate strain-induced change of inductance. Upon successful demonstration, we will build a 3-D sensor.
2. Summary of budget expenditures for the period just completed (include project burn rate):

Per December 17, we have spent \$12,753. The current burn rate is \$5,499 per month.

3. Numbers of faculty and student participation resulting from the funding, including internships:

Three faculty (Dr. Peter Müllner, PI; Dr. Nader Rafla, co-PI; Dr. Paul Lindquist, assistant research professor), one graduate student (Tony Hobza, Materials Science and Engineering), and one undergraduate student (Charles Patrick, Electrical Engineering) participate in the project.

4. List patents, copyrights, plant variety protection certificates received or pending:

K. Ullakko, K. Sasaki, P. Müllner, "Sensor Device", Non-Provisional Application (13/652,293) for United States Letters Patent.

5. List technology licenses signed and start-up businesses created:

N/A

6. Status of private/industry partnerships (include enough information to judge level of engagement):

We submitted a Letter of Intent "Smart Material Machine Medical Service Delivery" to the NSF. Two companies headquartered in Boise are partners in this project and we will submit a full proposal to the NSF request for proposals 13-587 Partnership for Innovation: Building Innovation Capacity. These companies are AceCo and WestVet.

7. Any other pertinent information that will indicate to the council that the project is meeting satisfactory progress.

We submitted a pre-proposal "High Precision Magnetic Shape Memory Actuators for Space Applications" to ISGC for the NASA-EPSCoR program with NASA partners. While these are non-private partners, success in this program will boost commercialization capacity.