LLNL MBARI ASTEP project update

3/1/2007

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Background

LLNL is working for MBARI on a NASA-sponsored project "An Environmental Sample Processor for Deep-Sea Seep and Hydrothermal Vent Applications" from the solicitation "Astrobiology Science and Technology for Exploring Planets" (ASTEP). The goal is to develop a polymerase chain reaction module for oceanographic microbiology in MBARI's ESP by 3/2008. The work areas are:

Task 1: Design the PCR module, 4/2006 – 9/2006.

Task 2: Fabricate and test a prototype, 10/2006 – 3/2007.

Task 3a: Fabricate and integrate production modules into the ESP, 4/2007 – 9/2007.

Task 3b: Support production modules, 10/2007 – 3/2008.

Summary of recent activity (2/3/2007 – 3/1/2007)

We are assembling the prototype PCR module. Figure 1 shows some of the major components.

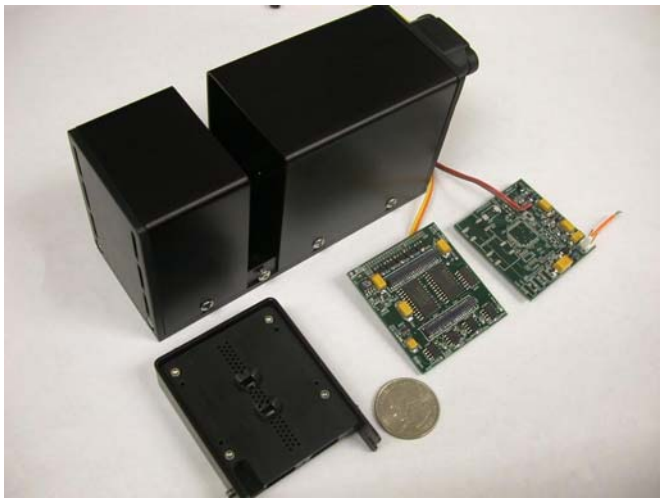

Figure 1. Some of the major components of the prototype ESP flow-through PCR module in assembly 2/28/2007: heater module (bottom left), analog board, digital board, and enclosure. The quarter will not be included in the production module.

All of the packaging hardware was completed. Some of the hardware that is fabricated by circuit-board technology was nearly completed but is now waiting on a particular milling machine for the final cutting step. This includes the thin-film heater, copper heat distributor, LED boards,

detector boards, and base board. This cutting will be a quick step once the machine is up, and there are only a few parts left to load.

The digital electronics board was completed and passed testing with the exception of the – 9 V supply section. We started debugging the – 9 V supply, which is needed to drive the amplifiers and integrators on the analog board. The analog board was partially completed and tested with the digital board to verify temperature measurement and control of the fan and LEDs.

We implemented the software for low-level control functions according to the specifications in the ESP PCR Module Requirements and Interface Specification Version 1.0, 10/11/2006. This level of implementation includes everything in Table 2 of that document except PROGRAM, DATA, and PIDTEMP. Once the PID is implemented, the software will be capable of running real-time PCR by a user issuing a series of RS232 commands to set the temperature and perform the fluorescence measurement. This manual approach is what will be used for the first demonstration of real-time PCR in the prototype module.

Upcoming activity

We plan to complete the assembly of the prototype PCR module by 3/9/2007, and then demonstrate real-time PCR in the prototype by 3/16/2007. We will present the flow-through sample to the module using an APDS-style fluidics workstation, and control the PCR module from a separate laptop computer. The process will be implemented somewhat manually using low-level RS232 commands (set temperature (TEMPC), turn on LEDs (LED ON, LED OFF), and read fluorescence (DIODE)).

At the end of March, we should be able to send MBARI a functional digital board. This will allow testing the communications between the ESP core controller and the PCR module controller.

The following statement was made last month, but still holds: In the technology transfer area, we need to work with MBARI on the interface with the ESP core, particularly the microfluidic interface, the chemical process including nucleic acid cleanup, and the signature and dye chemistry. The software and electrical interfaces are better specified and on firmer ground at this point.

Schedule and budget

As of 2/24/2007, the total spent was 294 k$ and 156 k$ remain, which includes additional funds-in of 142 k$ and expenses of 76 k$ in February. We understand that the current funding needs to last through April. We are under-budget and behind-schedule, as discussed above, and are aiming to make the PCR demonstration in the prototype 3/16/2007. As noted last month, one mitigating factor in the delay is that the prototype will be closer to the final design fidelity than we initially intended.