In the past week I attempted to make a casting from the molds I have already fabricated. The mold castings are made of mixture of Barium Titanate and Polyethylene Glycol. The mold casting will be subjected to high heat for sintering and later gold sputtered on either side to make a conductive surface. This will in turn create a transducer for the mouse experiments. The optimum shape for the transducer should be curved. This will focus the ultrasound propagation into the jaw of the mouse.

Although the ultimate design will be a transducer that is curved, I attempted to make flat transducers as well as curved so that I may gain the most experience and produce the very best transducers possible. Three molds were used in total; one curved and two flat. The first attempt to make a mold casting ended in failure. I poured a 50% weight Barium Titanate and 50% weight Polyethylene Glycol mixture, that had been melted together at 100C, into all three of the molds. Once the molds were filled I placed all three molds into a medium heat oven (300C) to pre-sinter the material before placing the castings into a high heat oven for full sintering. In the medium heat oven, the Polyethylene Glycol, which acts as a binder to the Barium Titanate, burned off as Carbon Dioxide gas and water vapor, this left large pot holes in the mold castings. As a result, all three of the mold castings were unlivable and broke apart into a powder.
The second attempt was to use but less binder, 1% Polyethylene Glycol. The less binder will leave smaller pot holes when it burns off. Because the binder content is so low however, the mixture will not melt together to be poured into the molds. I then used the Caver machine press in the Biomaterials lab (Bron 215) to press fit the mixture into the molds. The pressure used was 5,000psi. After the press I placed all three molds into the medium heat oven at 300C. The results from the second attempt faired better that the first. There were no pot holes left in the casting, and the material was not powdery, but was “flaky”. Although the castings made with lower binder content and at 5,000psi were flaking and had been partial sintered, they were still not viable enough for me to remove them from there molds to be placed in the high heat oven (1200C).

Figure 1. New mold design

I was not about to let this stop me, I came in on Saturday morning and was determined to find a solution. Because the material from the second attempt had been partially sintered I believed that I was on the right track. The problem was that they were
not strong enough to remove from the mold to be placed in a crucible into the high heat oven. I decided to use a mold that would allow me to remove the casting from the mold much more easily. Being that it was a weekend, the machine shop was closed, so machine a forth mold was out of the question. I decide to use a metal washer. It would allow me to “sandwich” the washer-mold between to flat objects so that the Barium Titanate and Polyethelyne Glycol could be pressed into the washer-mold. I pressed the washer-mold multiple times, placing additional mixture in the center of the washer each time to ensure that maximum pressure was reached in on the material and not along the edge of the washer.

The results from the second attempt were even more promising, the mixture was almost completely sintered and left a large chunk of barium titanate crystal. However, removing the mold casting from the washer-mold was still costly, and created a lot of chipping around the edge of the transducer, these are not expectable for the mouse experiment.

Although we have a working circuit that fulfills all the project specifications, we were asked to make a circuit that has integrated circuits rather than discreet by Dr. Enderle and Mr. Price. Because of this I researched a article that describes an ultrasound producing circuit that uses integrated circuitry. The parts have been ordered by me and have already been received.
Future Work: In the following week I will continue to fabricate transducers. I have spoken with Dr. Kotha about my recent progress and failures and he appears optimistic that I will have a working transducer soon. Future attempts will be to cook the mixture in the mold all the way to 1200C in the high heat oven without removing it from the washer-mold. Also I will try to make a rubber insert for the washer mold so that the mold casting may be removed from the washer mold before it is heated. If the washer-mold proves effective I should be at the machine shop in Castlemen where I will make a washer-mold that is capable of producing a curved transducer.

I understand that the fabrication of the transducer is holding up the animal test portion of the project. Given that we already have a working circuit, one made of discrete components, all we need is a transducer to conduct animal test. Because of this I discussed with Dr. Kotha the possibility of continuing the animal test with flat
transducers that can be purchased of the self. He told me that we already have some flat PZT material. And that we will need to cut them to size, apply a coating by vapor deposition, and they are ready to go.

Time permitting, I will soon be using the parts that I have ordered to put together the circuit described in the article.

**Hours worked in the past week:** 20

**Money spent:** $0