I believe creativity and technology complement each other. With the new possibilities and production capability of advanced technology—including a 3-D printer, metal artists can have more time and energy to focus their creative activity rather than mundane and time-consuming production processes. As one of the major progressive metalsmithing programs in the nation, The Metalsmithing and Jewelry area of the University of Iowa recognized the importance of this pursuit. For the past seven years, our students, Professor Chunghi Choo (my colleague) and I have been working with the local industries to use advanced technologies, such as laser cutting, to multi-production designs such as bottle openers, pictures frames and business cards holders. We have had great success as many of those pieces have gotten into competitive exhibitions. We are also aware of the fact that technology is advancing at a tremendous pace and keeping up-dated takes enormous effort and financial support. I am very grateful to the university and the community for their support in helping me to carry out my research. Last spring, I received the University of Iowa Academic Technology Advisory Council Innovations in Instructional Computing Award. The Grant helped to purchase the “Dimension SST” 3-D printer (Stratasys) which can generate real world 3-D ABS plastic modules for researches and artistic creativity. I am very thankful to Mr. Boyd Knosp and Mr. Steve Beck for their support in this project. We started testing the “Dimension SST” 3-D printer in March. I managed to do some tests and finish a piece of jewelry by using the 3-D printer before my two-month summer travel (I gave presentations in Hong Kong and curated two international metal work shows in Korea). The brooch was exhibited in Korea in the international exhibition, I was curator for, last summer and it was published at the Lazertran web-site.
I titled my brooch I made with our 3-D printer “baby brooch”. In that brooch (see attached images of the “baby brooch” on page 4), I use the ABS plastic (made from the 3-D printer) as significant parts of the brooch: The main back ground (the bread), the rectangular platform and the dome shape (breast). The rectangular platform and the dome shape is connected to the bread by a ball bearing which is also make of ABS plastic by the 3-d printer, so it can rotate around to enhance the dramatic effect of the piece. The baby image and characters on the brooch look like they are made of paper, but they are actually made of metals, paints and printing ink. For the baby image, I make silver look like paper by bleaching it with nitric acid, then the baby photo image is transferring onto it using a lazertran image transfer technique. For the characters, I airbrushed white acrylic paint onto brass first, to make it look like paper, then transfer the characters onto the acrylic with laser print ink. In this piece I orchestrate two very common but contradicting old Chinese sayings: the first is from Confucian-the love for food and sex is just part of the nature of human beings; the second is from Buddhism-natural instances such as the love for sex are empty and unfulfilling at the end. I also made models of my flatware designs with the 3-D printer, allowing me to test for comfort and functionality (see attached images of the flatware on page 8 & 9).

My students started utilizing the 3-D printer for a wide range of objects, ranging from furniture models to earrings. Faculty from other disciplines of the University has also started using it to advance their research. In the art school, the design area is also utilizing the 3-D printer and will integrate it into its curriculum. ITS AT Research Services (ATRS) has assigned a staff member, Daniel Langstraat to support investigators who want to use the 3D Printer. ATRS has started promoting this resource to researchers and have created a web page and other communication materials for it. ATRS has also done some pilot work using data from the confocal microscope in the Central Microscopy Research Facility and from medical imaging scanners in the hospital. We are planning to contact faculty who expressed interest in this project when we wrote the grant and invite them to use the printer. The Metalsmithing and Jewelry program also advertises it in their brochures and area functions such as the annual donor luncheon. Mr. Boyd Knosp
from ATRS and I are now try to finalize the cost model. The funding generated will be use for its maintenance and future development.

I have had opportunities to test run three different kinds of 3-D printers, I find the “Dimension SST” 3-D printer has many benefits over its competitors. The software that runs the SST printer is easy to understand and has many options, so it is user friendly and yet powerful. The structure is well built, well designed and simple, making it reliable, easy and inexpensive to maintain. The “Dimension SST” 3-D printer uses ABS plastic as printing material. ABS plastic is comparatively safe and cheap for 3-d printing, other printers involve usage of harmful and expensive chemicals. ABS plastic is also strong so it can actually function as the real parts, minimizing time to translate the model materials into other materials. If necessary or desirable, the ABS plastic also can be used for casting and electroforming.

Although I only have two to three months time to work with the 3-D printer due to my heavy summer traveling schedules, so far I am very happy with the printer. I already introduced it as part of the course work in the curriculum of the Metalsmithing and Jewelry program. I eventually intend to develop a course that is focused on 3-D printing.
Applications of "Dimension SST" 3-D printer in my work

Kee-ho Yuen

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the Metalsmithing and Jewelry program
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"Baby brooch"  2004
3 1/4" x 3 1/4" x 1"
ABS plastic, silver, gold, aluminum, lazertran transfer ink and acrylic paint.

The bread background, the platform and the dome shape of the brooch are made with ABS plastic directly by the 3-D printer. The rectangular platform and the dome shape are connected to the bread by a ball bearing which is also made of ABS plastic by the 3-d printer, so it can rotate around to enhance the dramatic effect of the piece. For the baby image, I made silver look like paper by bleaching it with nitric acid, then the baby photo image is transferred onto it using a lazertran image transfer technique. For the characters, I airbrushed white acrylic paint onto brass first, to make it look like paper, then transferred the characters onto the acrylic with laser print ink. In this piece I orchestrate two very common but contradicting old Chinese sayings: the first is from Confucian - the love for food and sex is just part of the nature of human beings; the second is from Buddhism - natural instincts such as the love for sex are empty and unfulfilling at the end.
The 3-D designs of the baby brooch parts are first drawn and rendered in a computer with the software Rhinoceros. The finished drawings are saved as stl (stereolithography) file format which then can be sent to the 3-D printer for printing.

“Dimension SST” 3-D printer (Strata sys)  72 x 27 x 41 inch (right) with door open showing the extrusion head and plastic modeling base (left).
Based on the 3-D model data from the stl file, the catalyst software regenerates another set of data of the 3-D model, representing it as if it is composed of many thin layers each .001" thick (imagine cutting a carrot into many thin layers). The 3-D printer then uses the new data to generate the 3-D model by extruding layer by layer of bead of ABS plastic through a computer controlled extrusion head; I liken the 3-D printer to a high-tech hot glue gun. The extrusion head also has a tip for support material which supports the modeling material during the whole printing process as necessary. The support material can be separated from the modeling material by submerging the finished pieces into hot water inside the cleaner.

“Dimension SST” 3-D printer cleaner
The Catalyst software showing the image of the model that will be printed (left image). The red lines on it correspond to the locations of the slices (right image) in the model.

Part of the "Baby Brooch" (right image) is finished and will be integrated with other materials to produce the piece. The ball bearing can be seen easily after the supporting material has been removed (left image). The ball bearing allows the platform to spin. The texts on the lower right corner are just a test of how well laser print ink can be transferred to the ABS plastic surface.
For the flatware project, I used the same steps as in the "Baby Brooch". I made models of my flatware designs (especially the handles) with the 3-D printer so I would know that it was comfortable and functional. The handle of the flatware is later made of anodized aluminum, and the functional parts (spoon, blade and fork) are made of 12 gauge silver. (The aluminum handle is made with the help of Mr. Herbert Dircks of the Engineering design and prototyping center, UI. My sincere thanks for his generous help.)

The ABS plastic models of the flatware are made by the 3-D printer.
Flatware  2004
8" x 1 1/2" x 1"
Silver, gold and anodized aluminum