Introduction
Nickel Titanium exhibits shape-memory or superelastic effect coupled with good corrosion and abrasion resistance as well as biocompatibility. This makes it a material of choice for biomedical applications such as bone implants. The current problem is that bulk NiTi is too stiff to be a good bone substitute. Creating foams out of metals reduces their stiffness and allows bone ingrowth inside the voids. Having a way to finely control the porosity is thus required to have optimal properties of the implant.

![Figure 1: (a) Shape-memory effect. (b) Superelastic effect](image)

Aim
The aim of this study is to create NiTi foams with 3D interconnected pores. To have a high control over the porosity, high-carbon content steel wires are used as space-holders. Those wires are then removed via electrochemical dissolution.

Experimental Setup
A frame is first built by stacking steel wires. It consists of 25 layers of wires stacked at 0°/90°. NiTi powder is poured into the frame and the resulting composite is then hot pressed. Steel wires are then dissolved using an electrochemical cell.

![Figure 2: Steel frame](image)  ![Figure 3: Hot-pressing setup](image)

Microstructure
The porosity obtained after using this new processing technique replicates the steel frame. Pores are three-dimensionally interconnected and conserve their straight and elongated initial shape. The only modification is the cross-section aspect ratio of the wires. Due to the load during the hot-pressing step, wires are deformed in an ellipsoidal shape.

![Figure 4: (a) & (b) SEM pictures of resulting foams](image)

Mechanical Properties
In order to characterize the shape-memory effect of the foam, a load-unload-recovery cycle compression test was done.

![Figure 5: Load-unload-recovery curve](image)

As there is mainly only elastic deformation, the sample recovers totally its shape after unloading. The shape-memory effect is thus hard to characterize.

Conclusions
This new processing technique allows:
- Quasi full densification of the NiTi matrix
- High control over the porosity parameters such as interconnectivity, shape and volume fraction
- Formation of TiC layer preventing Fe diffusion in the NiTi matrix
- However little to no plastic deformation due to oxide layer at the powder boundaries.