A device with the ability to ionize gases is needed for a variety of applications, of which the mass spectrometer (MS) [1-2] is one of the most important. The ionization method in the majority of gas analyzers in MS is electron-impact ionization, which uses a beam of electrons that collides with gas molecules. Through this collision process, energy is transferred from the electrons to the gas molecules, which causes electrons on the gas molecules to be stripped off (i.e., ionization of the gas molecules).

Traditionally, thermionic emission, which consists of a filament that produces electrons when heated, is the most common way of generating electrons for MS using electron impact ionization. However, thermionic emission has several disadvantages: slow switch-on time, large power consumption, and lack of robustness. These disadvantages, however, are eliminated when field emission is used instead.

In this project, a double-gated silicon field emission device is used to generate the electron source for electron impact ionization. Figure 1 shows a SEM picture of a double-gated silicon field emission device used here. Using this device, we have demonstrated the linear relationship between the emission current ($I_E$) and the ion current ($I_I$) at a fixed pressure (10^-4 torr) as shown in Figure 2.

### Figure 1: The SEM picture of the cross section of the silicon field emission and field ionization array.

### Figure 2: Plot of emission current ($I_E$) and ion current ($I_I$) versus gate voltage (VG).

**REFERENCES**
