As cell density increases, device characteristics improve. Suspect this is a processing phenomena linked to stress that is induced while performing liftoff. An on/off ratio of six orders of magnitude was observed, and current density increases with device scaling.

Future Work

- In-depth testing & results verification
- Investigate solution for asymmetric work functions
- Implementation of larger crossbar arrays containing both a selector device and a memory element

The electron affinity of TiO₂ varies widely with the degree of crystallinity of the film. This in turn leads to variation in the work function difference between the electrode and the insulator, which makes it hard to predict exact device behavior. Crystallization can potentially lead to better on/off current ratio in the oxide, but also decrease the functional voltage margin.

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Goal: To determine whether a Ni/TiO₂/Ni structure can function as a selector device for crossbar memory arrays

- Characterize MIM structure
- Determine the extent of non-linearity present in I-V’s
- Compare against known criteria and determine whether Ni/TiO₂/Ni is suitable as a selector device

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Ideal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Density</td>
<td>≥ 10 kA/cm²</td>
</tr>
<tr>
<td>On/Off Ratio</td>
<td>≥ 10⁹</td>
</tr>
<tr>
<td>Operation POLA</td>
<td>Bipolar</td>
</tr>
<tr>
<td>Scalability</td>
<td>Compatible with Memory Element</td>
</tr>
</tbody>
</table>

Currently, the most common non-volatile memory choice is NAND flash, with utilizes the structure shown in figure 01.

New non-volatile memories use crossbars, as in figure 02. This allows for the very simple integration of a selector device into a process for a bipolar operated crossbar memory device:

A test layout was created containing 3X3 crossbar arrays as well as individual cells. Allows for testing the influence of neighbor cells by comparing results between isolated cells and cells included within an array.

Cell sizes vary from ½ square microns to 16 square microns.

Custom process flow was designed and implemented. All depositions performed with electron beam evaporation.

Current densities of 10kA/cm² achieved with ½ micron features. Asymmetric current response likely due to oxidation of the bottom nickel electrode.

Corner cells display the least desirable nonlinear behavior, while center cells display the largest nonlinearity observed.

- In-depth testing & results verification
- Investigate solution for asymmetric work functions
- Implementation of larger crossbar arrays containing both a selector device and a memory element

- Dr. Santosh Kurinec
- Dr. Robert Pearson, Dr. Lynn Fuller, Dr. Dale Ewbank, and the SMFL Staff