Fabrication of Integrated Passive Devices
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Introduction
Washington Nanofabrication Facility (WNF) is the largest public access micro/nanofabrication facility in the Pacific Northwest. Capabilities of the facility include photolithography, thin film deposition, etching, packaging and metrology.

The current work was performed at the WNF and involves fabrication of test wafers with integrated passive devices (IPDs) for RF applications.

Passive devices such as inductors, capacitors and resistors do not require energy for their operation. Embedding passive devices during fabrication as seen in Figure 1, has the following benefits over using discrete components:

- Smaller size
- Lower Total Cost
- Improved Electrical Performance
- Improved reliability

Method
IPDs are typically fabricated using the photolithography process. Fabrication of one of the layers of the device is explained in this section. The as received silicon wafers are cleaned and a thin film of silicon dioxide is deposited using plasma enhanced chemical vapor deposition (PECVD). The required pattern is then transferred to the substrate using the photolithography process shown below.

1. Silicon substrate with a copper seed layer and spin coated photoresist
2. Exposure of the photoresist
3. Development of resist
4. Deposition of copper
5. Stripping of photoresist
6. Etching of copper seed layer

Figure 1. An example of a device with IPD components

Discussion
The parameters that were modified to obtain good translation of features include soft bake time and temperature, exposure and developing times.

Characterization using an optical microscope provided useful information for the optimization process. For example, a 60 second exposure was found to overexpose the resist, whereas a 50 second exposure was found to work well. This helped in arriving at an optimal exposure time for the photoresist used.

Equipment

- PECVD Tool
- Spin Coater
- Exposure Tool
- Electroplating Tool
- Example of a Photomask

Conclusion
Process parameters for fabricating one layer of the integrated passive device were identified and good repeatability was observed.

Further work would involve optimizing recipes for the other layers of the device, fabricating and testing the final device.

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References
2. https://www.wnf.washington.edu/