# Microinductors for Spacecraft Power Electronics

Erik Brandon, Emily Wesseling, Victor White, Udo Lieneweg, Hilary Cherry, Adam Krause, and Judy Podosek
*Center for Integrated Space Microsystems*
*Jet Propulsion Laboratory*
*California Institute of Technology*
*4800 Oak Grove Drive, Pasadena, CA 91109*

To enable the next generation of smaller planetary spacecraft will require significant reductions in the mass and volume of the power electronics.[1] A significant barrier to miniaturization of the power subsystems are the dc-dc converters, which rely on discrete magnetic components such as inductors and transformers. One way to achieve miniaturization of the converters is to reduce the size and volume of the magnetic components using fully integrated components fabricated through silicon compatible processes. Electrodeposition has played a key role in the development of these components, for deposition of both copper conductors and thick magnetic layers.

Several investigations over the last 20 years in the area of thin and thick film magnetic inductors have yielded promising results.[2,3] Future work, however, will need to focus on the design of these components for specific applications. Application to a dc-dc converter will require optimization of the components for power density and efficiency primarily at a given frequency through choice of appropriate materials as well as optimal component design. Finite element analysis can provide many clues to maximizing inductance per unit area at a given frequency. Moving to higher frequencies enables smaller inductance values, but moves beyond the operating limits of most modern magnetic materials due to eddy current losses.

At the Jet Propulsion Laboratory, we have investigated several different microinductor designs for use in integrated, on-chip dc-dc converters (Fig 1). Both sputtered CoZr based amorphous alloys and electroplated NiFe based alloys have been used and compared at various frequencies using different microinductor designs. This paper will focus on the optimization of microinductors for application in a 1 MHz dc-dc converter.

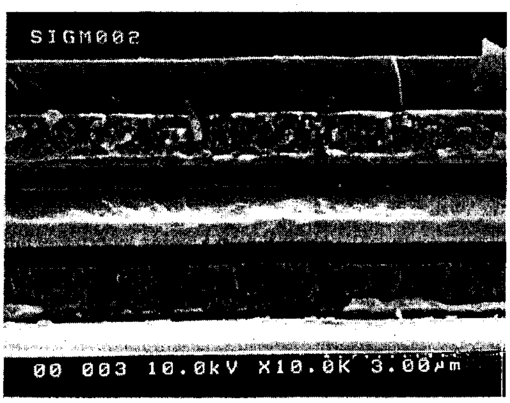


Figure 1. SEM cross-section of a microinductor incorporating CoZr amorphous magnetic alloys.

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2. R.F. Sohoo, IEEE Trans. Magn. **15**, 1803 (1979).

3. M. Yamaguchi, H. Okuyama and K.I. Arai, IEEE Trans. Magn., **31**, 4229 (1995).