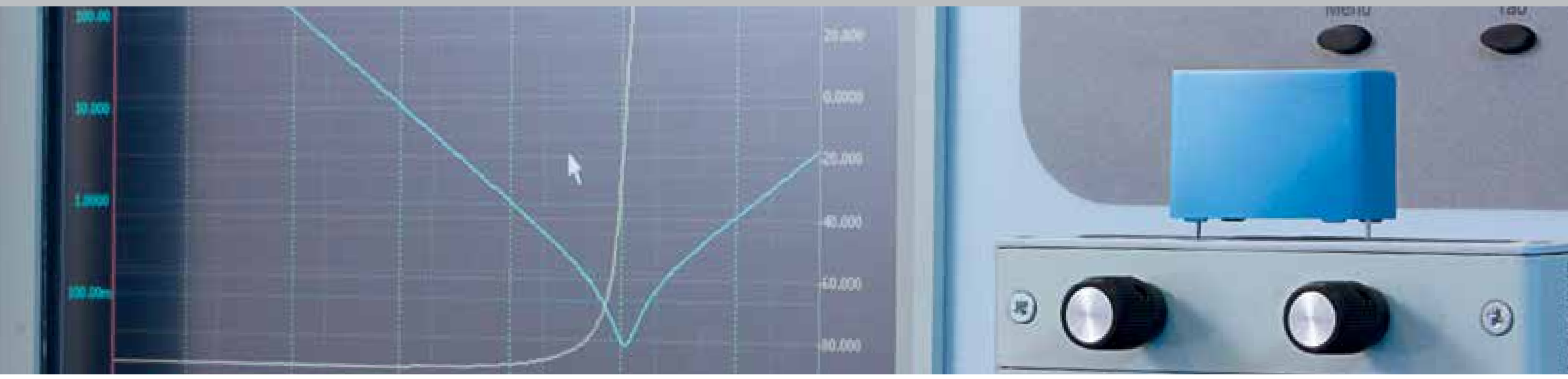
Fraunhofer IISB

FRAUNHOFER INSTITUTE FOR INTEGRATED SYSTEMS AND DEVICE TECHNOLOGY



1 *Impendance measurement of a capacitor*

CAPACITORS

CHARACTERIZATION FOR POWER ELECTRONIC APPLICATIONS

What we aim for

- Characterization of new capacitors (ceramic, film, etc.)
- Evaluation of their potential for power electronic applications
- Evaluation and modelling of life time and reliability
- Reduction of volume and cost
- Improvement of the thermal management and increasing the power density

Characterization

- Impedance analysis of dielectric materials and capacitors dependent on frequency, temperature and voltage (DC bias)
- Hysteresis of capacitors and dielectric materials
- Leakage current (temperature-dependent)
- Thermal behavior, thermal impendance and resistance

Reliability test

- Temperature and humidity tests
- Passive thermal cycles
- Power cycling of capacitors

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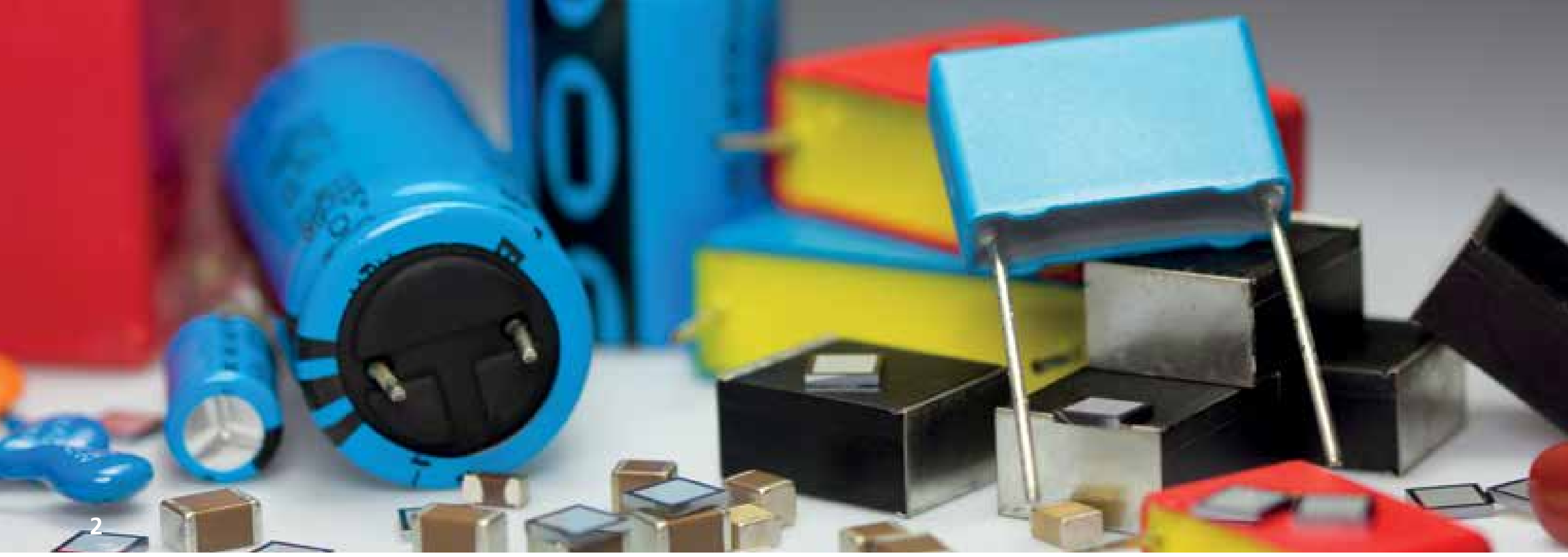

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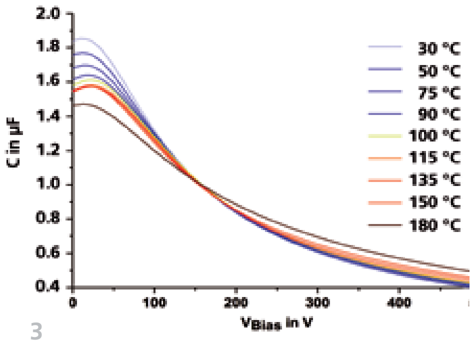
Failure analyses

- Cross section analysis and optical inspection
- Scanning electron microscopy and material analyses via EDX
- Lock-In-thermography
- Focused ion beam preparation

Example measurement on ceramic capacitors

- Temperature dependence of MLCC is important at low DC bias voltage only
- Influence of DC bias voltage on the capacitance is dominant at high voltages
- Fig. 4 shows energy density calculated from the data from Fig. 3
- High temperature has a small positive effect on the energy density
- Example for voltage and current waveforms to stress capacitors in IISB's reliability test setup (Fig. 6)
- Testing under different electrical conditions (voltage, current, frequency and environmental conditions)
- Measurement of thermal impedance at different cooling temperatures



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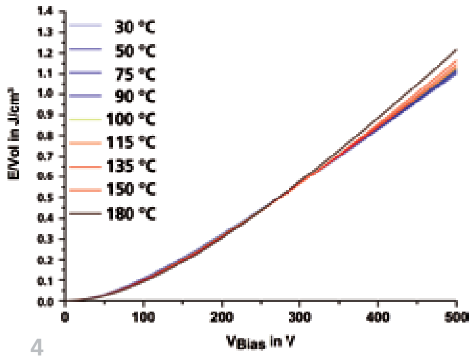

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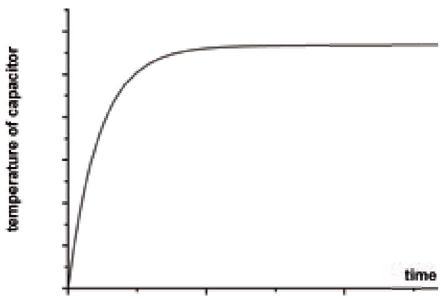

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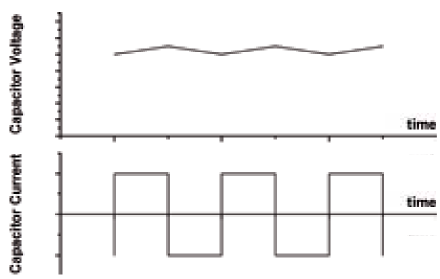

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2 Diversity of capacitors characterized and analyzed at IISB

3 Capacitance of a X6S MLCC under different DC bias voltages and temperatures

4 Energy density of MLCC for different DC bias voltages and temperatures

5 Temperature of specimen during stress test

6 Voltage and current waveforms applied to stress a capacitor