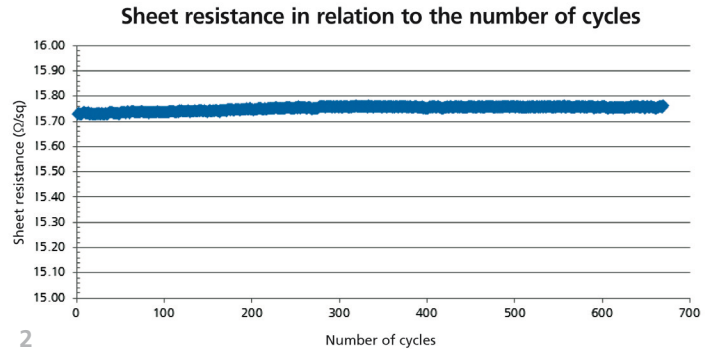


1



- 1 Curve test.
- 2 Sheet resistance in relation to the curve cycle.

## DISPERSIONS FOR HEATING ELEMENTS

### Starting point

When manufacturing heating elements for specific uses with a high variety of products, different heating performance, small quantities and flexible systems, new requirements arise which cannot be met with traditional heating elements.

### IPA's approach to a solution

Dispersionen auf Basis von Kohlenstoffnanopartikeln ermöglichen die Herstellung flächiger Heizelemente und werden mittels Standard-Beschichtungsanlagen erzeugt.

Dispersionen based on carbon nanoparticles allow flat heating elements to be manufactured and are created using standard coating processes.

Thin film layers, low mass, quick heating times, flexible substrate materials and automated manufacturing processes present advantages over other processes. Fraunhofer IPA's dispersions can be processed/applied via several different coating techniques, such as spray coating, dip coating, screen printing and doctor blades. The dispersions possess the following properties:

- Solids content: 3.8 – 4.8 wt%
- pH value: 7.5 – 9
- Surface tension: 60 – 70 mN/m
- Viscosity: 25 – 60 mPa-s

The heating elements manufactured using Fraunhofer IPA's dispersions are able to fulfil the following properties:

- area performance up to 28 W/cm<sup>2</sup>
- sheet resistance: from several k Ω/sq to 30 Ω/sq
- power supply of 5 V to 230 V
- surface temperature of up to 300 °C
- coating thickness of 3 μm to 15 μm

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Number of cycles	Heating	Cooling (via fan)	Temperature reached
0-3385	60 seconds	12 seconds	Approx. 90 °C
3386-7690	120 seconds	12 seconds	Approx. 100 °C

Sample number	Before test	After 3385 cycles	After 7690 cycles
1	92 Ω	87 Ω	87 Ω
2	103 Ω	100 Ω	100 Ω
3	107 Ω	104 Ω	104 Ω
4	110 Ω	105 Ω	105 Ω
5	91 Ω	90 Ω	90 Ω
6	84 Ω	80 Ω	81 Ω

3

4

### Our range of services

We are pleased to offer support in the design of the dispersion and heating element, as well as for the coordination of the manufacturing processes and integration in applications.

We are developing innovative solutions for this purpose, especially for the wide range of different products with varying performance levels.

By working with you, we can develop concepts in future for areas including selective heating zones, transparent heaters, complex surfaces and self-regulating heating systems, for example.

### Your benefits

Our dispersions improve and increase the degree of automation and lead to a reduction in weight, which means costs can be lowered and profitability can be increased.

In comparison with traditional heating elements, the operating temperature of our flat and thin heating elements is considerably reduced. In this way, thermal strain is lowered for the component parts, therefore prolonging life cycle.

We are happy to help by providing solutions for your individual requirements.

**3** *Planned thermal stress on the samples.*

**4** *Electrical behaviour of the samples during the tests.*