Modified Screen Printing of Crack-Free Ceramic Layers

Introduction

The screen printing process is widely used to produce ceramic thick layers and ceramic structures on arbitrary substrates. Screen printing is applicable to almost any ceramic powder which can be mixed with an organic binder to obtain a paste of high viscosity. After printing the paste, the binder is removed by pyrolysis and ceramic structures are sintered at or above 1000°C.

State-of-the-art

For example, screen printing is applied to produce embedded passive components (resistors or capacitors) in multilayer circuits, chemical gas detectors, piezo-actuators or pressure sensors, ceramic conductors (i.e. electrodes), optical waveguides on silicon or infrared detectors. A wide variety of microstructures comprising numerous materials can be manufactured.

However, the major drawback of screen printing is related to insufficient control of the sintering step. Since one cannot expect a uniform distribution of powder particles in the paste, sintered microstructures are often warped and even cracks in ceramic layers may occur. Also shrinking of printed components during sintering has to be taken into account. Any post-processing of hardened and brittle ceramics is expensive and can give rise to up to 50% of the manufacturing costs.

Invention

The invention proposes a modification of conventional screen printing which largely overcomes the disadvantages mentioned above. Excellent layer quality and precisely defined microstructures can be maintained during sintering, and compact crack-free sintered products are achievable by introducing two simple process step modifications.

First, the paste is prepared from an inventively modified ceramic powder with enhanced fine grain portion. Second, after sintering, for high quality crack-free layers and surfaces a special infiltration step is suggested. The infiltration is very easily performed and demands no further equipment.

The invention is especially useful for producing IR detectors (see also fig. 1). However, it is also suitable for any ceramic device i.e. where high value is set on uniformity of layers and/or on precisely following microstructuring.

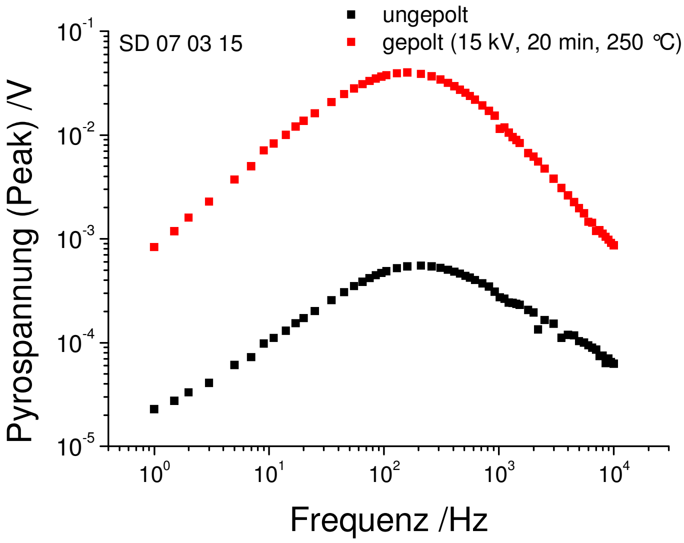

Figure 1 Example for a PZT layer as IR detector. The pyroelectrical voltage measured under chopped laser illumination (680 nm, 24 mW) is given vs. chopper frequency for poled (red) und unpoled (black) layers.

Developmenr Status

The invention has been carried out successfully in laboratory experiments. Transfer to industrial level seems straightforward and should cause no major difficulties. A laboratory sample for evaluation purposes could be supplied on request.

IP right status

A German patent was granted in February 2005.

Licensing

Companies established in the market of ceramic components, i.e. piezo ceramics, are sought as potential licensees or patent purchasers. A license or purchase contract can be accompanied by a know-how transfer agreement and/or a R&D project.

Contact

PVA SH GmbH
Dr. Dirk Lukas
Wissenschaftszentrum
Fraunhoferstr. 13
D-24118 Kiel

Tel. (0431) 800 99 35
FAX (0431) 800 99 33
E-Mail lukas@pva-sh.de