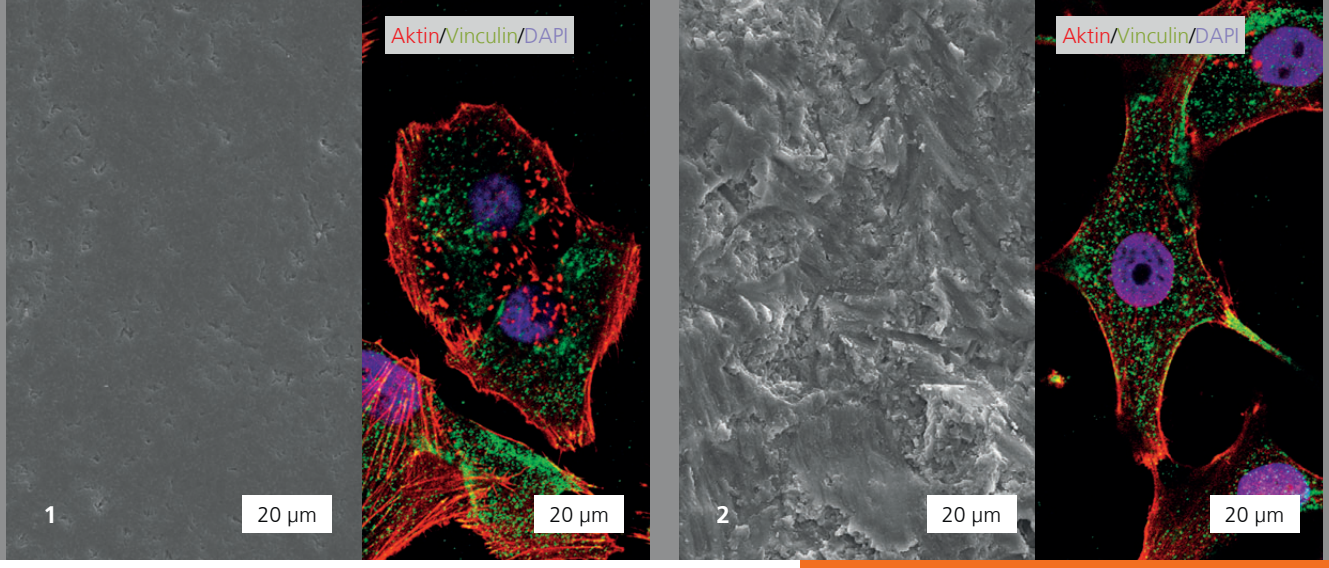


ANALYSIS OF CELL ATTACHMENT AND CELL SPREADING ON SILICON NITRIDE

Dr. Susanne Kurz, Dr. Juliane Spohn, Dr. Eveline Zschippang

Silicon nitride (Si_3N_4) is an advanced ceramic with a unique combination of material properties and is ideally suited as a material for implants. It is chemically stable and has a high stiffness, hardness, strength and fracture toughness. It is also extremely wear-resistant. Recent research has shown that not only is it biocompatible, it also displays antibacterial behavior. Designing the surface topography in a targeted way will significantly influence the cell adhesion and osteoconductivity. Therefore, Fraunhofer IKTS develops biocompatible Si_3N_4 and performs surface finishing processes to modify the surfaces.

Influence of surface on attachment and spread of osteoblasts

The connection between surface structure and osteoblastic cell behavior can be demonstrated by lapping and sandblasting, examples of surface finishing processes (MG63 cells). Lapping results in an average surface roughness of 0.03 µm, whereas sandblasting achieves an average roughness of 1.3 µm. There are also differences with regard to the wettability of the surfaces: The size of the contact angle is 41° for lapped surfaces, and 54° for sandblasted surfaces. Biological investigations of the cell adhesion and cell spreading behavior yield reduced spreading of the individual cells after 24 hours of cultivation on the rougher, less hydrophilic surface (sandblasted, Figure 2), compared with the smoother and more hydrophilic surface (lapped, Figure 1). The amount of vital cells adhering to the surface is not affected by the surface finishing processes used in this study. As a next step, effects of the altered cell spreading behavior on the osteoblastic functionality of the cells will be investigated.

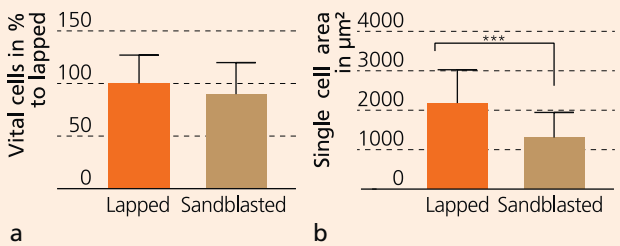
Surface structuring and optimization

Sandblasting of Si_3N_4 is one possibility to alter the material surface and consequently influence the cell behavior. Other surface structuring methods, such as laser structuring, are available for producing textured surfaces optimized for biological concerns. Moreover, the chemistry, and thus the hydrophilicity of the Si_3N_4 surface, can be specially modified by thermal processes in an inert or oxygen-containing atmosphere to further optimize the surface for biological applications.

Services offered

- Research and development of silicon nitride materials, optimization of properties
- Osteo/immunological cell analysis on modified biomaterial surfaces

Cell adhesion (a) and cell spread (b) of osteoblasts (24 h)



SEM (no cells) and fluorescence laser scan of osteoblastic cells
1 *on lapped* Si_3N_4
2 *and on sandblasted* Si_3N_4.

Contact Eveline Zschippang • Phone +49 351 2553-7983 • eveline.zschippang@ikts.fraunhofer.de