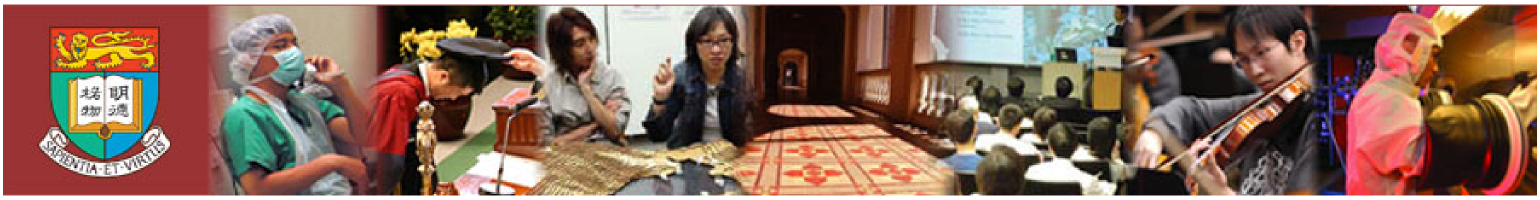

Title	Characterization of a new polysiloxane-based titanium surface treatment for resin titanium bonding
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Table 1 – Binding energies of $Ti2p_{1/2}$, $Ti2p_{3/2}$, Si2p and O1s.

Sample	Binding energy (eV)			
	$Ti2p_{1/2}$	$Ti2p_{3/2}$	Si2p	O1s
Polished	464.3	458.6	102.1	530.0
Sandblasted	464.3	458.6	103.2	532.6
Polysiloxane coating + 800 °C treatment	464.2	458.5	104.2	529.7
Polysiloxane coating + 1100 °C treatment	464.3	458.6	101.8	529.8

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Characterization of a new polysiloxane-based titanium surface treatment for resin titanium bonding

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Purpose: To characterize the polysiloxane-coated titanium surface with thermal treatment by XPS and AFM. Such a novel coating might significantly enhance resin bonding.

Methods and materials: A layer (~2 mm) of silicone grease (Dow Corning Co., Michigan, USA) was applied on two titanium plates (Permascand, Ljungaverk, Sweden) followed by a thermal treatment at two temperatures, 800 and 1100 °C, respectively. Another titanium plate was surface treated by sandblasting. The atomic composition of titanium surfaces and change of chemical states of Ti2p, Si2p and O1s were examined by X-ray photoelectron spectroscopy (XPS). The surface morphology and surface roughness were examined by atomic force spectroscopy (AFM).

Results: Change in binding energies for Si2p and O1s peaks were observed after surface treatment by sandblasting and a polysiloxane coating with thermal treatment (Table 1). No observable changes in binding energies for Ti2p was obtained. There was a change in atomic composition of titanium surfaces after different surface treatments. There were changes in surface morphology of titanium after surface treatments. The average surface roughness, Ra (μm), of titanium was increased after sandblasting and thermal treated of polysiloxane-coating: polished (0.179 ± 0.027), sandblasted (0.642 ± 0.033), polysiloxane-coated at 800 and 1100 °C (0.316 ± 0.056 and 0.898 ± 0.064).

Conclusion: Both the physical and chemical characteristics of the titanium surfaces were changed by the surface modification using a polysiloxane coating with thermal treatment. These changes on the titanium surface might affect the resin titanium bonding.

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Effect of veneered zirconia framework design on residual thermal and occlusal stresses: FEA study

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Purpose: The aim of this study was to analyze, using a 3D finite element model, the residual thermal stress distribution and occlusal stress distribution in a veneered zirconia crown regarding the framework design and the cooling protocol.

Methods and materials: 3D models of second lower molar veneered zirconia crowns were built with two different core designs: uniform (U) or anatomic (A). Heat transfer analyses were conducted with two cooling protocols: slow (S) and fast (F). The output of temperatures was used to calculate thermal stresses. The non-linear change in porcelain modulus and coefficient of thermal expansion close to its T_g was taken into account. An occlusal load (400 N in two 1 mm^2 contact area at the buccal cusps) was applied in the pre-stressed crown, cemented in the tooth. The maximum (s1) and minimum (s3) principal stresses at the porcelain were analyzed.

Results: Slowly cooled models showed higher tensile stresses (s1 peak – SU: 32.8 MPa; SA: 27.6 MPa; FU: 18.7 MPa; FA: 24.5 MPa) and lower compressive stresses (s3 peak – SU: −46.8 MPa; SA: −61.2 MPa; FU: −13.1 MPa; FA: −11.0 MPa) throughout the porcelain layer. Tension-free zones were shown in their occlusal and cervical regions, while compression-free zones were shown in the same regions of slowly cooled models. Regarding the framework design, for slow cooling protocol, the anatomic model showed larger tension-free zones at the occlusal face, lower s1 peak and higher s3 peak. After occlusal loading, the tensile stress values increased in the lingual face and decreased in the cervical region of buccal face, but the general pattern observed in residual thermal stress distribution was maintained.

Conclusion: The stress distribution of slowly cooled models is more prone to protect the porcelain from crack propagation, because of the tension-free zones in the occlusal and cervical regions. Not only the residual thermal stress, but also the final stress distribution of slowly cooled anatomic model was more favorable to prevent porcelain chipping.

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