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FAILURE AT THE DENTAL RESTORATIVE-ETCHED ENAMEL INTERFACE

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None of the restorative materials available to the dental profession adhere to tooth structure. Buonocore[1] demonstrated that the bonding of these materials could be greatly increased by etching the enamel surface prior to the placement of the restorative material. Conditioning of the enamel surface with phosphoric acid or an attenuated phosphoric acid solution is now an accepted procedure and widely applied in restorative and preventive dentistry.

During the development and subsequent laboratory evaluation of these new dental materials, the resin-enamel bond strength is determined by means of tensile loading tests. In addition the site of failure is often recorded as occurring within the material, partly within the material and at the interface, at the interface, within the enamel or a combination of the above factors.

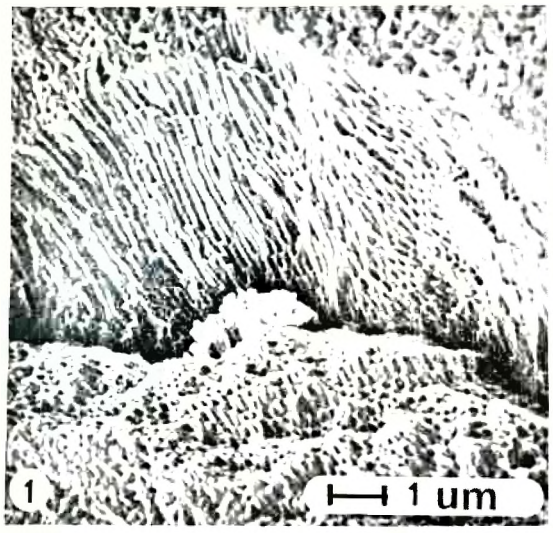
An epoxy resin formulation has been developed in the Dental Research Unit for the direct bonding of orthodontic attachments to enamel surfaces. The bond strength of this formulation to enamel surfaces etched with 50% phosphoric acid was determined by a method developed by Hanke[2]. The test jig consists of a series of joints assembled to produce a universal joint which eliminates as nearly as possible all forces other than tensile during the application of the load.

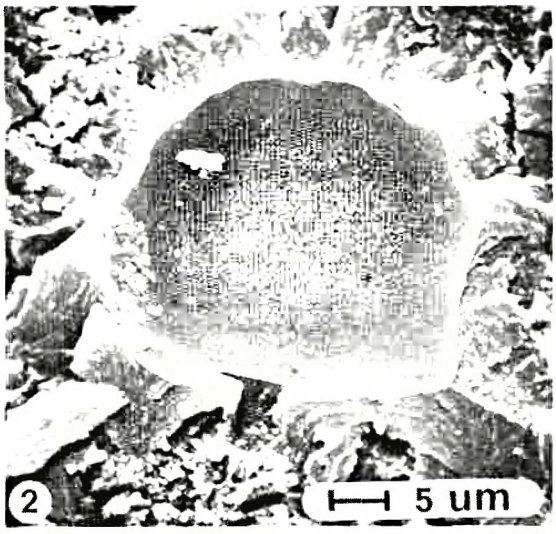
After failure of an experimental bond, two surfaces result, namely, the enamel and adhesive surfaces respectively. Both these surfaces were examined by scanning electron microscopy in six specimens selected at random in which the adhesive-enamel bond strength exceeded 8,0 megapascals.

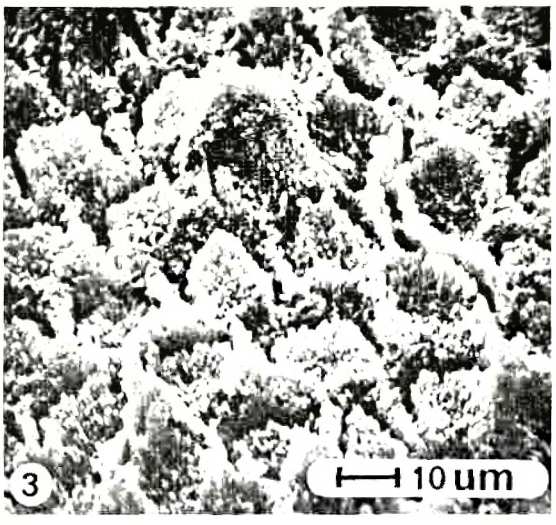
The results indicate that minute fractures within enamel (Fig. 1) or adhesive (Fig. 2) cannot be detected by conventional means. Furthermore, failure does not occur at the enamel-adhesive interface. An etched enamel surface demonstrates the preferential etching action of phosphoric acid (Fig. 3) while the enamel aspect of a fractured bond has a "veiled" appearance (Fig. 4).

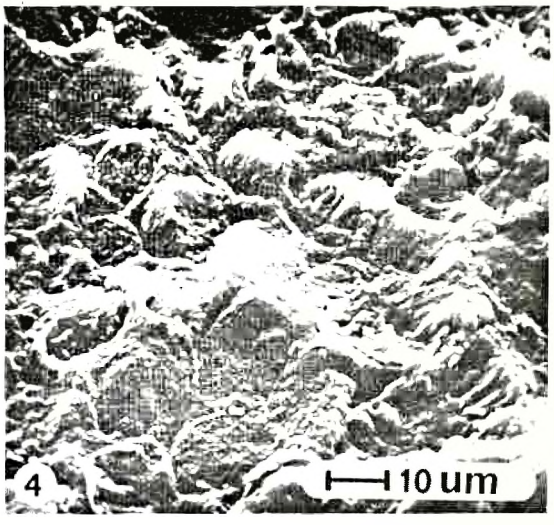
A model to explain interfacial failure is proposed: A clean interfacial break (Fig. 5) differs substantially from that obtained in practice (Fig. 6). This was confirmed by surface roughness measurements and atomic absorption spectrometry.

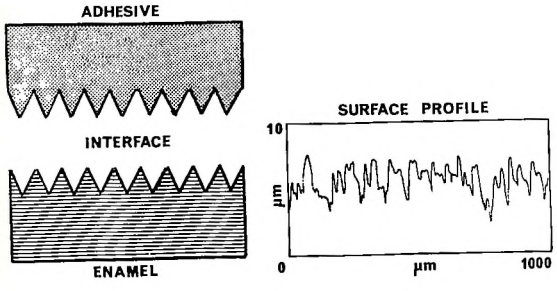
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1. Buonocore, M.G. J. Dent. Res. 34, 849-853 (1955).
2. Hanke, G. M.S. Thesis, Indiana University School of Dentistry (1968).



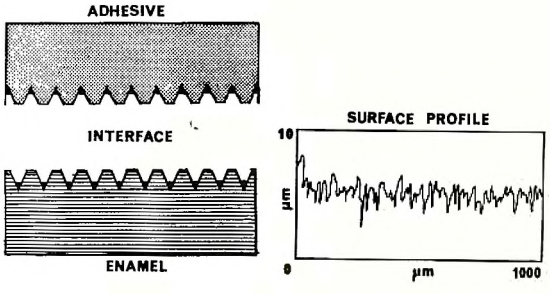








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