EXCIMER LASER INTERACTION WITH DENTIN OF THE HUMAN TOOTH

Introduction

It is well known that light amplification by stimulated emission of radiation is represented by the acronym laser. This project had its beginning in the quantum electronics department of the IBM Thomas J. Watson Research Center in Yorktowne Heights, New York. Using a excimer laser, whose frequency is in the deep ultra-violet region of the spectrum, produced many unusual conical structures within the dentin of the inner part of the human tooth.

Structure of Tooth

The structure of the tooth consists of the crown, neck, pulp cavity and root. The crown is the part of the tooth that is covered by enamel and projects beyond the gum line. The neck is the narrow area of the tooth, and the pulp cavity is that area which contains a soft vascular and sensitive organ called dental pulp. The root of the tooth is the area which is the embedded part of the tooth.

Description

Examination of the structures of the enamel reveals the following characteristics. It is the hardest, most compact part of the tooth which forms a thin layer over an exposed crown. It consists of a collection of small hexagonal rods and columns which lie parallel to each other. Dark lines mark the mode of formation of the rods (Fig. 3). The enamel's chemical composition consists of 96.5% earthy matter (phosphate with the carbonate of calcium, with traces of fluoride of calcium and phosphorous magnesium) and 3.5% animal matter.

The composition of dentin differs from that of enamel in that dentin is the calcareous part of the tooth beneath the enamel which forms the greater mass of the tooth and also covers the exposed part of the crown. Microscopic examination shows that dentin consists of a number of minute wavy branches called dentinal tubuli which are embedded in a dense homogeneous substance known as the intertubular tissue. Dentin is composed of 28% animal matter and 72% earthy matter. The cortical substance, cementum, a thin layer on the root of the tooth extends from the termination of the enamel to the apex of the root. This cortical substance chemical compound resembles bone in that it contains lacunae and canaliculi.

Method and Results

The dentin of various molar teeth were exposed to 1300 pulses to 4000 pulses using an excimer laser. The results indicate some very unique structures occurring within the dentin. The interaction of the laser light seemed to form unusual conical structures within the dentin. Using false color (when all of the gray levels have the same value, the computer will pick a particular color and the next value up or down will show as a different color) permits the eye to see detail that would not normally be visible under normal perceivable gray levels.

Conclusion

By varying the frequency of the laser one can disperse the energy and cause more bleeding in laser surgery, but not destroy the cells associated with the incision. Therefore, the healing process will virtually be without scarring. Whereas, using the infrared laser the blood loss would be less, but the healing process would tend to be longer because cells are being destroyed due to the cauterization effect of the laser. The question is, are these structures produced as an interaction with the laser or are they an intrinsic part of the structure? We are still studying the effects of the laser interaction upon dentin, and in using the EM we will be able to understand more clearly the interaction of the excimer laser upon the tooth dentin and other various biological tissue.

The Effects of Laser Interaction upon Dentin

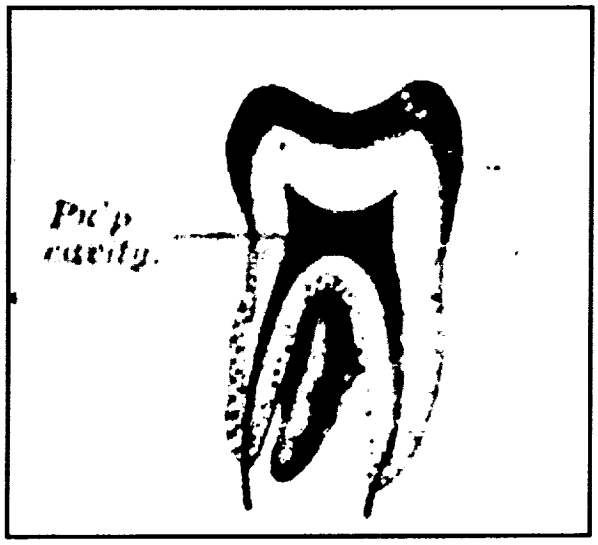


Figure 1

Figure 2

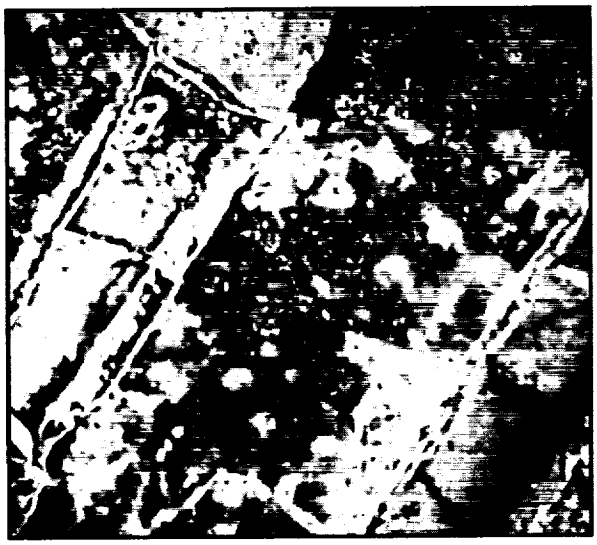


Figure 3

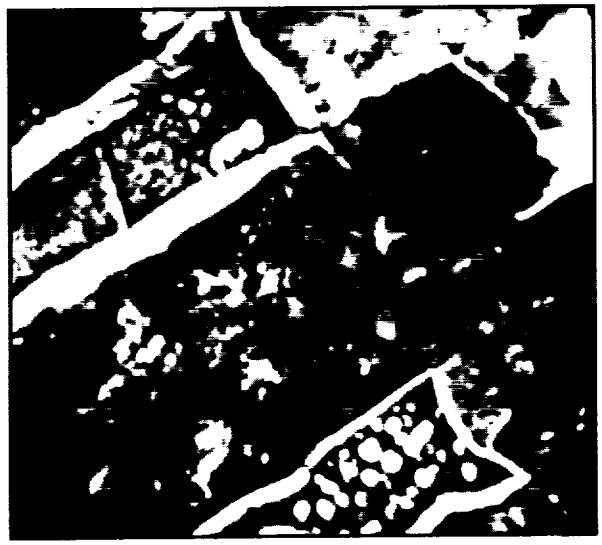


Figure 4

Figure 5

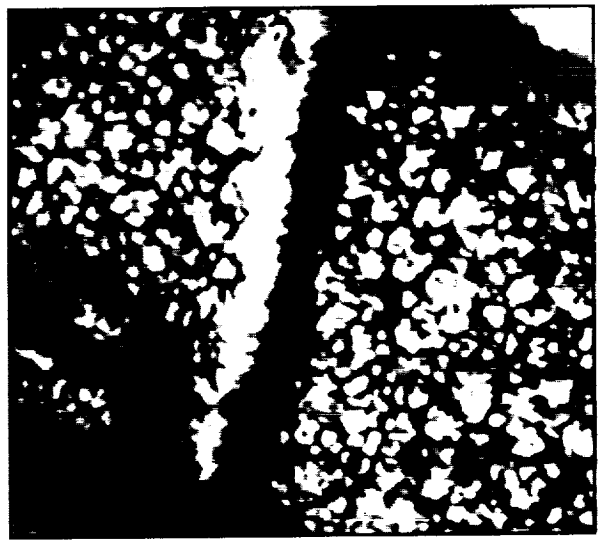


Figure 6

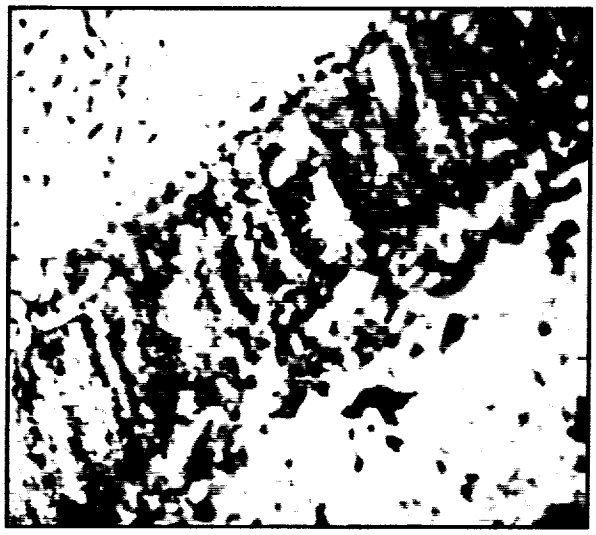


Figure 7

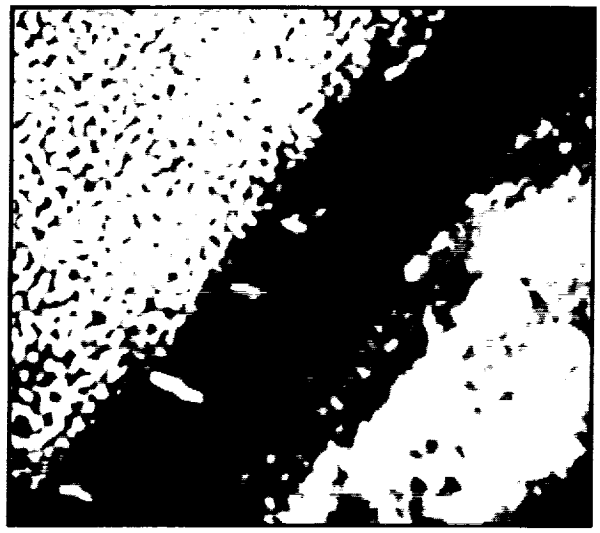


Figure 8

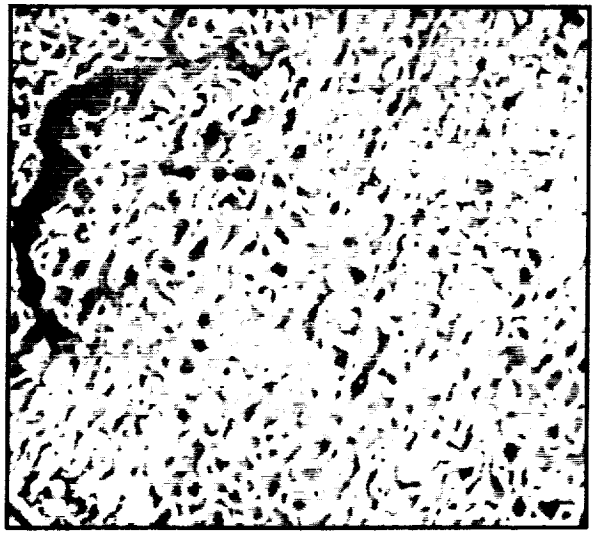


Figure 9

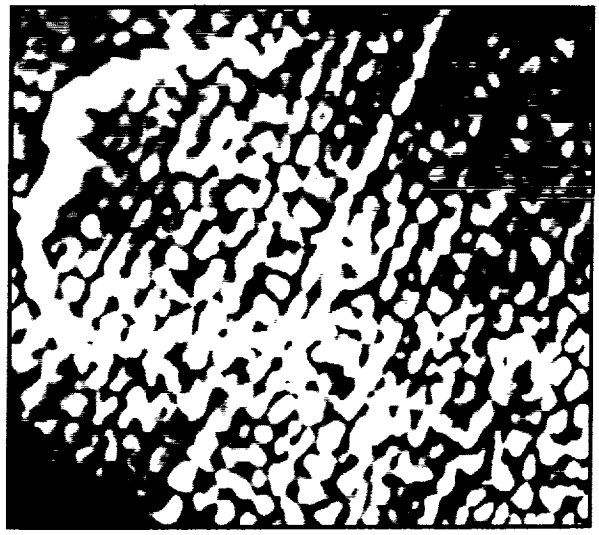
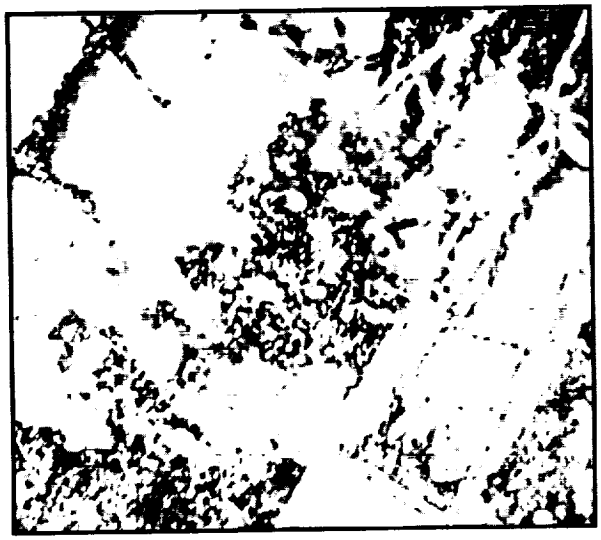


Figure 10



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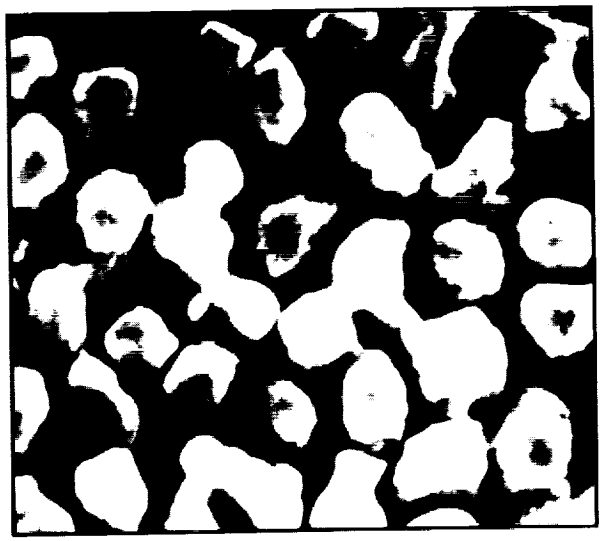

Figure 12