

## **Dedication**

**To the spirit of my father .**

**To my family (mother, sisters and my brother).**

**To all my great teachers.**

**To all colleagues, friends and anyone who helped  
me to finish this research. .**

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## **Abstract**

The objective of this research was the utilization of laser induced breakdown spectroscopy (LIBS) technique to determine the spectroscopic changes in caries teeth. Q-Switched Nd:YAG laser with 10 ns pulse duration, 100 mj energy per pulse, 2 Hz repetition rate was used.

Five caries teeth were used as samples. Each tooth has been divided into three regions for irradiation; the first region is the health, the second is the region of caries and the third region is the edge between the health region and the caries region. Each region was irradiated with the same parameters.

The laser beam was focused on the sample to achieve high power density leads to very high temperature in the focal volume and then undergo a number of reactions resulting in formation of plasma of the sample. This plasma emits discrete emission lines which represent the fingerprint of the sample.

A spectrometer connected to PC was used to collect and record the emission spectra of the samples plasma. The recorded spectra were processed by subtracting: the dark current, the pumping flashlamp and the background radiation.

The elements in the emission spectra were identified after referring to the atomic spectra database.

A comparison was done between the sample contents in order to determine the spectral differences between the health part and caries part of each tooth.

The results showed that certain elements were found in all the five samples with different amounts while some elements were not found in all the five teeth.

In general, the elements and ions that were appeared in the health region, and started to decrease then disappeared in caries region, are: Praseodymium (PrII), Terbium (Tb), Manganese (MnII), Cerium (CeII), Neon (NeII), Strontium (Sr), Xenon (Xe), Krypton (Kr) .

In addition to that, the elements and ions that were appeared in the health region in certain amounts, and decreased in the caries region, are: Europium (EuII), Zirconium (ZrIII), Gadolinium (GdII), Yttrium (YII), Cerium (CeIII), iron ion (FeII), iron (Fe).

Finally, the elements and ions which were not appeared in the health region and appeared in the carious are: Thorium (Th), Cerium (Ce), Ytterbium (Yb), Fluorine (F), Bismuth (Bi), Krypton (Kr), Chlorine (Cl II), Sodium (NaII ), Beryllium (BeIV), Chlorine (Cl), Hydrogen (H).

## المستخلص

الهدف من هذا البحث هو استخدام تقنية مطيافية الانهيار الكهربائي المستحث بالليزر لتحديد التغيرات الموجودة في خمس عينات مختلفة من الاسنان المتسوسة. استخدم ليزر النيديميوم - ياك ذي التشغيل المفتاحي النبضي بزمن نبضة مقداره 10 نانوثانية وبطاقة نبضة مقدارها 100 ملي جول وبتكرارية مقدارها 2 هيرتز.

قسمت كل سن الى ثلاث مناطق لغرض التشعيع المنطقة الاولى هي السليمة وكانت الثانية هي المتسوسة اما الثالثة فهي منطقة الحافة بين المنطقة المتسوسة والمنطقة السليمة.

ركزت حزمة الليزر على العينة للحصول على كثافة قدرة عالية تؤدي الى ارتفاع في درجة حرارة الجزيئات عند بؤرة الحزمة عندها تحصل عدة تفاعلات تؤدي الى تكون البلازما من العينة. هذه البلازما لها خطوط انبعاث طيفية مميزة تمثل بصمة تعرف بها الذرات والايونات المكونة للعينة. استخدم جهاز مطياف مربوط بجهاز الحاسب لتسجيل الانبعاثات ومعالجتها عبر برنامج حاسوبي للتخلص من طيف المصباح المستخدم في ضخ الليزر وتيار الظلام والاشعاع من الوسط المحيط. حددت العناصر الموجودة في كل عينة بواسطة الخطوط الطيفية المنبعثة وذلك بعد الرجوع الى قاعدة بيانات الاطياف الذرية للذرات والايونات. تمت المقارنة بين مكونات كل عينة وذلك لغرض تحديد الفروقات الطيفية بين الجزء السليم في السن والجزء المتسوس.

اوضحت النتائج ان هنالك بعض المكونات موجودة في كل العينات الخمس بكميات متفاوتة في حين ان بعض المكونات لا توجد في كل العينات.

كل التغيرات التي حدثت في العينات الخمس اوضحت ان كل عينة تحتوي على كميات محددة من العناصر التي تختلف عن العينات الاخرى خصوصا في حالة التسوس فهناك عناصر تظهر واخرى لا تظهر وهذا يعتمد على طبيعة وتركيب السن نفسها.

وعليه فان العناصر والايونات التالية : (NeII), (CeII), (MnII), (Tb), (PrII), (Sr), (Xe), (Kr) ظهرت بشكل واضح في الجزء السليم من السن وبدا بالتناقص الى ان اختفت في حين ان كل من (YII), (GdII), (ZrIII), (Fe), (FeII), (CeIII) ظهرت ايضا في الجزء السليم من السن ولكنها بدأت بالتناقص اكثر في منطقة الحافة وازداد التناقص اكثر في منطقة التسوس.

من ناحية اخرى فالعناصر والايونات التي لم تظهر في الجزء السليم من السن بينما  
ظهرت في الجزء المتسوس فهي (Th), (Ce), (Yb), (F), (Bi), (Kr), (CIII), (NaII), (BeIV), (Cl), (HI)  
تسوس الاسنان. مما يعني انها عناصر جديدة تبدأ تتكون عند

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