RAMAN SPECTROSCOPY ANALYSIS OF FS LASER INDUCED STRUCTURAL DAMAGE ON SODA-LIME GLASS

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Selective etching is an important process in electronic and medicinal instrument manufacturing. However, it is a time-consuming process thus reducing manufacturing speed. It is known that chemical etching rate (using potassium hydroxide KOH) of corona-charge treated domain of the soda-lime glass substrate is 1.6 times higher than that of normal glass [1]. Furthermore, it was observed that chemical etching rate (using potassium hydroxide KOH) of fs laser induced damage areas of soda-lime glass is up to 1000 times higher. The purpose of this study is to analyse structural changes of soda-lime glass when affected by fs laser pulses.

Soda-lime glass is composed of silicon dioxide (SiO_2), sodium carbonate (Na_2CO_3) and calcium oxide (CaO) compounds. The structural network is formed by silicon and oxygen compounds in the shape of tetrahedrons, also known as Q species. Q species are connected by bridging oxygen atoms (Fig. 1). Alkali and alkaline earth elements work as network modifiers, consequently changing physical and chemical properties of the glass.

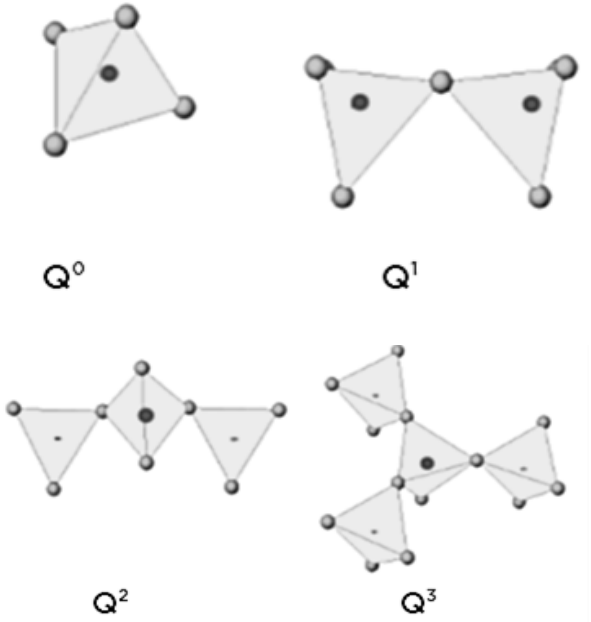

Fig. 1. Visualisation of Q group compounds

In this study, soda-lime glass samples were affected by a 1030 nm wavelength Bessel beam. Damaged samples were analyzed with Raman spectroscopy. This method was chosen because Raman shift values of Q species compounds are precisely known and do not depend on alkali metal compounds in the glass structure [2].

In this research, Raman spectroscopy was done with a 532 nm wavelength excitation beam. By analysing the measured spectra, structural differences between damaged and normal glass can be determined.

Analysis of the Raman spectra showed there was a noticeable difference in the quantity of Q^4 and Q^2 species compounds in the damaged glass compared to normal glass.

[1] Daisuke Sakai *et al* 2013 *Jpn. J. Appl. Phys.* **52** 036701.
[2] G.S. Henderson, H.W. Nesbitt, G.M. Bancroft, *Some Interesting Observations on Oxygen Environments in Silicate Glasses with Implications for the Fitting of the High Frequency Raman Envelope* (Cargese, France, 2017).