

## Report of the doctoral thesis

### „Curing of Visible Light Curing Resin Based Dental Composites“

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The thesis deals with an interesting problem of investigation of the curing condition in terms of irradiance, exposure time and irradiance distribution of light curing units on reaction kinetics as well as corresponding mechanical and viscoelastic properties of visible light curing resin based dental composites.

The thesis is divided to five parts corresponding to the common form of standard thesis. Introduction in appropriate way describes current status of the research and various approaches concerning of dental composites, photo-polymerization, methods for determination of curing proces and viscoelastic properties of visible light curing resin based dental composites using indentation methods. It is based on 137 quotations including the most recent literature. I appreciate nice description of dental composites based on visible light curing resin and method for determination of the curing state and their thermal, mechanical and viscoelastic properties. I have one question to this part. On the page 14 is ormocer describe as a „copolymer of organic monomers and inorganic ceramics“. Is it possible to speak about copolymer or it is composite of inorganic ceramics as a filler with polymers without chemical bonding between ceramics and polymeric matrix? (Respond at thesis defence)

The second part of the thesis describes of the methodology and purpose of the work. The methods employed in this work provide information about light curing unit characteristics, mechanical as well as curing parameters. The various experimental methods employed in this work is very clearly shows in the form of flow chart in Fig. 29.

To determine time dependent degree of conversion  $/DC(t)/$  for different curing conditions a Fourier transform infrared spectroscopy was used. Depth of cure  $/DoC/$  was measured by using differential scanning calorimetry. The surface hardness for visible light curing resin based composites under different curing conditions were measured at different time with hardness testing. I appreciate that the new dynamic mechanical indentation method to determine local viscoelastic depth and surface properties of visible light curing resin based dental composites was done by application of new sample holder and movable x-y stage to the dynamic mechanical analysis. I appreciate too that validation of indentation method by comparing the modulus measured in DMA analysis in three point bending mode with measurements in an indentation mode was done in this work.

Part Discussion of the Results is aimed to the main topics of the thesis:

- characterization of dental light curing units,
- measurement of the curing data of visible light curing resin based dental composites and modeling reaction kinetics,
- effect of curing condition on the properties of visible light curing resin based dental composites and
- effects on the post-curing on hardness evolution of visible light curing resin based dental composites.

The results which were published in cited papers are logically designed and discussed. I have three questions to this part of thesis (Respond at thesis defence):

1. Which type of LCU units from tested types it is possible to recommended to application from point of view of total irradiance and irradiance distribution?
2. The curing process can be considered to two steps – primary, thermally controlled process of curing in the liquid state with highly mobile radicals and monomers and diffusion controlled process of post-curing in the glassy state with inhibited mobility of radicals and monomers. Experimental data presented in the thesis (Fig. 34 and 36) shows relatively short curing time in which was realized only first step of curing process. How long was tested the second post-curing process and which type of DC curve were obtained in this state? Exist separation between the primary and post-curing process?
3. The formation of a crosslinked polymer network during photo-polymerization is fast process and the reaction rate reaches the maximum after few seconds, but creation of „frozen“ crosslinked polymer networks inhibited mobility in the glassy state and results of this process is degree of conversion only 50% (Fig. 47). Have you some results of chemical crosslinked structure? From Fig. 52 and Fig. 53 is evident, that post curing process, e.g. increasing of hardness with the time is very important from point of view of the properties of visible light curing resin based composites.

## **Conclusion**

The thesis is fully acceptable as a basis for awarding the author by scientific title „Philosophie Doctor“ Ph.D.

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