PHOTOCROSS-LINKED BIO-BASED POLYMERS FOR POTENTIAL APPLICATION IN OPTICAL 3D PRINTING

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The Aim of the Research

The aim of this study was to evaluate the effect of acrylated epoxidized soybean oil-based resin composition on photocross-linking kinetics and mechanical properties of the resulted polymers.

Photocross-linking

Photosensitive resins were composed of acrylated epoxydized soybean oil (AESO), different aromatic comonomers, synthetic divinylbenzene (DVB) or bio-based vanillin dimethacrylate (VDM), bio-based reactive diluent myrcene (MYR), and 3 mol.% of photoinitiator 2,2-dimethoxy-2-phenylacetophenone (DMPA). Commercial synthetic resin Autodesk PR48 Clear (REF) was used for comparison.
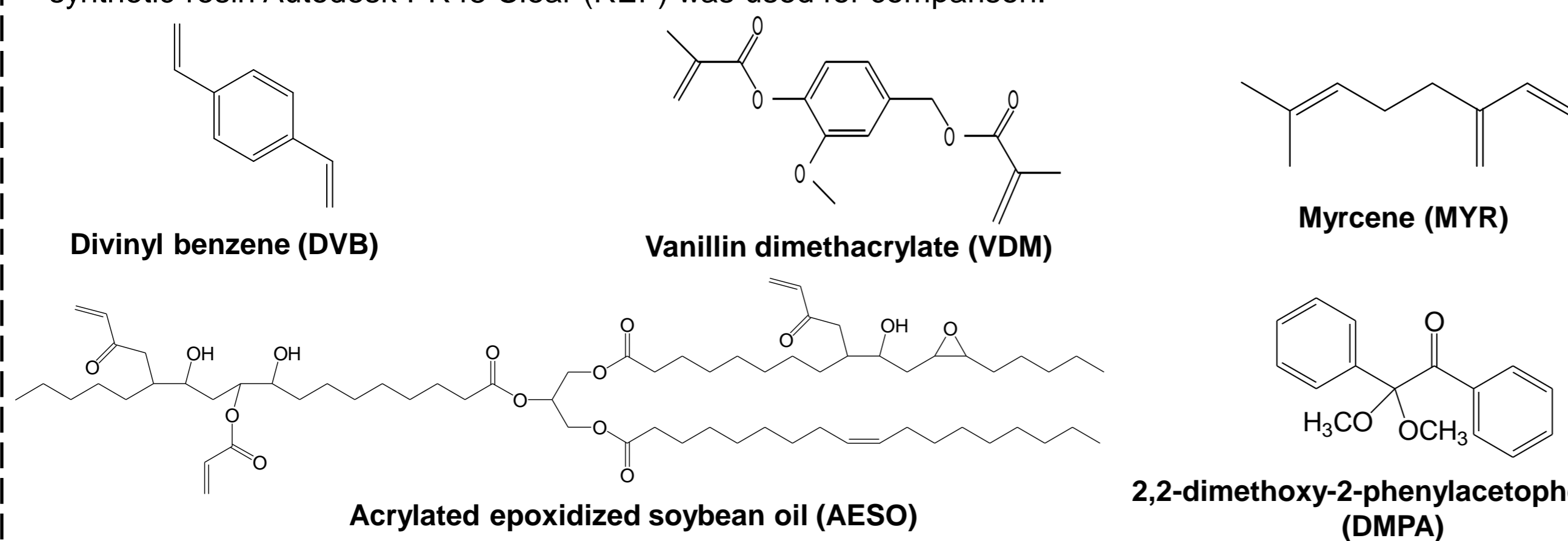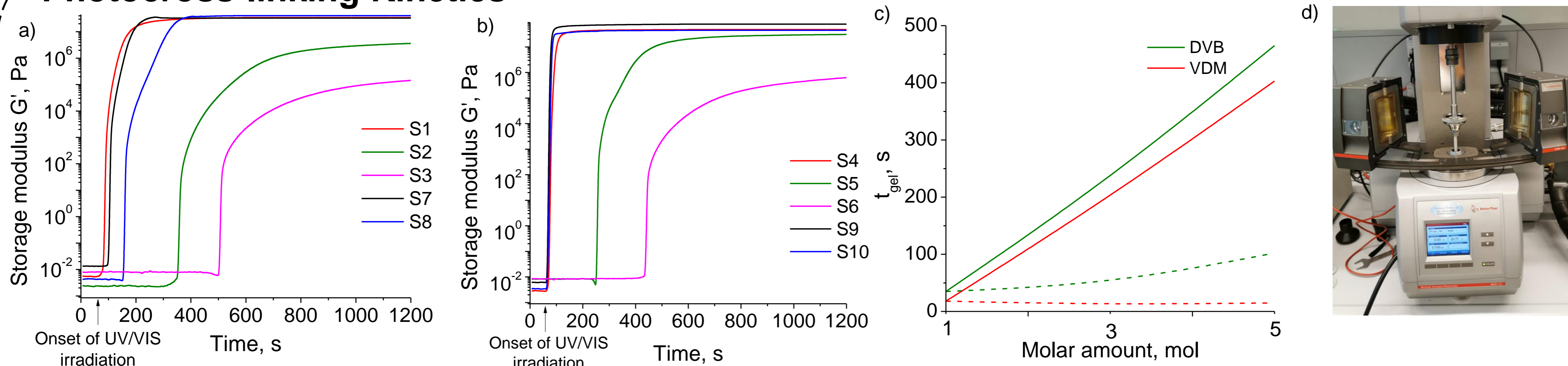
Sample No.	Molar ratio of AESO:MYR: DVB	Sample No.	Molar ratio of AESO:MYR: VDM
S1	1:1:1	S6	1:1:1
S2	1:1:3	S7	1:1:3
S3	1:1:5	S8	1:1:5
S4	1:3:1	S9	1:3:1
S5	1:5:1	S10	1:5:1

Divinyl benzene (DVB)

Vanillin dimethacrylate (VDM)

Myrcene (MYR)

Acrylated epoxidized soybean oil (AESO)

2,2-dimethoxy-2-phenylacetophenone (DMPA)

Photocross-linked polymer tablet (S7)

Photocross-linking Kinetics

Time dependencies of storage modulus G' of the resins with different aromatic compounds: DVB (a) and VDM (b). The dependency of the gel time (t_{gel}) of the resins on the amount of MYR (solid) and aromatic compound (dashed) (c) were monitored with rheometer MCR302 from Anton Paar equipped with the plate/plate measuring system (d). The samples were irradiated using UV/Visible spot curing system OmniCure S2000, Lumen Dynamics Group Inc.

Investigation of Polymers
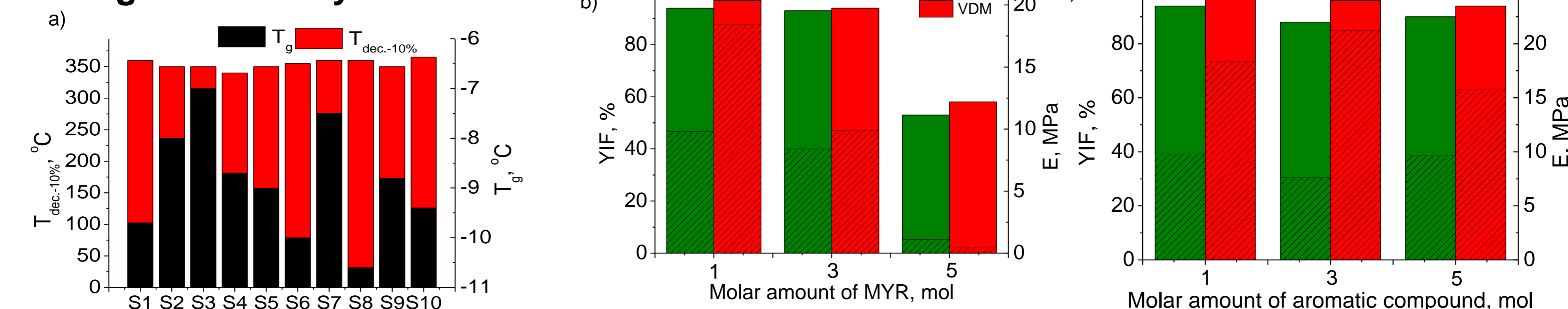
Thermal characteristics of photocross-linked polymers (a)

The dependency of the Young's modulus (E) (striped) and yield of insoluble fraction (YIF) (solid) of the polymers on the amount of MYR (b) and aromatic compound (c)

Conclusions

❖ The higher rate of photocross-linking, yield of insoluble fraction, and Young modulus values were obtained when vanillin dimethacrylate was used in compositions instead of divinyl benzene.

❖ Higher amounts of myrcene increased polymerization time, reduced storage modulus and yield of insoluble fraction.

❖ Photocross-linked polymer of acrylated epoxidized soybean oil, myrcene and vanilin dimethacrylate (sample No. 7) reached the highest yield of insoluble fraction and the best mechanical properties.

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