Electronic Supplementary Information for *Explaining the spread in measurement of PDMS elastic properties: influence of test method and curing protocol*

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1 Connectedness of existing literature

Litmaps software was used to create a connectedness diagram of all the studies used in this review shown in Figure ESI.F1. Lötters[1] is seen to be particularly commonly cited with work on PDMS.

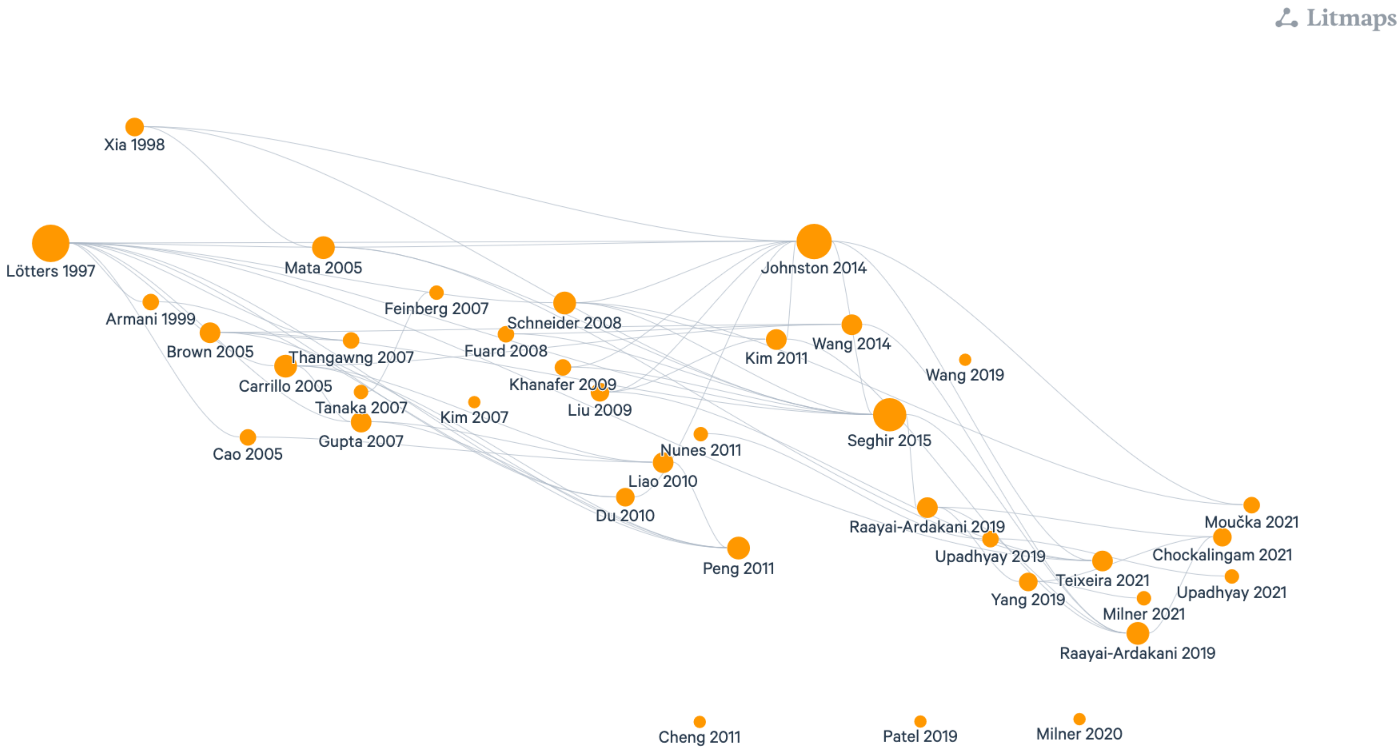

Fig. ESI.F1 Included studies show citation links between articles. Markers are sized based on relevance within the network and sorted chronologically from left to right, and vertically on a log scale by total citations in any field per the Litmaps Database[2]

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2 Additional data

Previously unpublished data included in this paper was collected with the method described by Chockalingam et al.[3] via cyclic loading between a radius of $a = 0.06$ mm and 0.08 mm with 400 seconds of relaxation. A neo-Hookean material model is considered and a non-linear least squares fitting is used to determine an initial defect size A (used to calculate a stretch λ) and shear modulus μ.

All samples are SYLGARD 184 mixed via a THINKY planetary mixer and cured at 100 °C for 2 hours. Sample identifiers indicate the composition used as S[w_{B+oil}]-[(w_{oil}/w_{B+oil})100] e.g. S40-10 is a 40:1 base to curing agent ratio with 10% non-reactive PDMS oil (μMicroLuburol, 350cSt). Reported shear modulus in Table ESI.T1 is the mean $\bar{\mu}$ of results collected for each rate of $\dot{a}$= 0.01, 0.02, 0.04, 0.08, 0.16, and 0.32 [mm/s] with a standard deviation calculated from all six rates for all trials, N, within a sample.

Table ESI.T1 Additional data presented in this work with associated composition and fit parameters for shear modulus and initial defect size

Sample ID	w_B+:w_{oil}:w_C	N_{trials}	$\bar{\mu} \pm \sigma$ [kPa]	$\bar{A} \pm \sigma$ [mm]
S55-10	50+5.6:1	2	3.65 ± 0.11	0.326 ± 0.01
S50-00a	50+0 :1	4	5.71 ± 0.16	0.319 ± 0.01
S50-00b	50+0 :1	3	4.71 ± 0.51	0.321 ± 0.01
S50-00c	50+0 :1	2	5.47 ± 0.29	0.342 ± 0.007
S50-10	45+5 :1	3	7.38 ± 0.37	0.366 ± 0.02
S50-20	40+10:1	3	7.24 ± 0.34	0.395 ± 0.006
S45-00a	45+0 :1	1	11.9 ± 0.24	0.448 ± 0.02
S45-00b	45+0 :1	4	10.6 ± 0.81	0.414 ± 0.03
S40-00	40+0 :1	4	14.4 ± 1.8	0.460 ± 0.02

3 Included studies

A summary of all studies included in the manuscript is listed in Table ESI.T2. Curing temperature listed as 25 °C for all room temperatures cures and specified as RT in the Heating Method column. Unspecified methods are abbreviated as UNS throughout.

Table ESI.T2 Summary of all included studies

Author	Test Type	Cure Temp [C]	Cure Time [hr:min]	Mix Ratio [base+oil: curing agent]	Heating method	Mixing and degas
Chockalingam 2021 [3]	VCCE	100	2:00	variable, Si Oil	Oven	Planetary mixer, vacuum degas 30 min
Raayai-Ardakani 2019 [4]	VCCE	40	72:00	variable	Oven	Planetary mixer, vacuum degas 30 min
Raayai-Ardakani 2019 [5]	VCCE	40	72:00	variable	Oven	Planetary mixer, vacuum degas 30 min
This work	VCCE	100	2:00	variable, Si Oil	Oven	Planetary mixer, vacuum degas 30 min
Milner 2021 [6]	Cavitation Rheology	25	144:00		RT	Planetary mixer, vacuum degas
Milner 2021 Thesis [7]	Cavitation Rheology	25	144:00	variable	RT	Planetary mixer, vacuum degas
Yang 2019 [8]	Cavitation Rheology	25	144:00	variable, Si Oil	RT	Planetary mixer, vacuum degas
Nunes 2011 [9]	Simple Shear	25	144:00	10:1	RT	UNS
Upadhyay 2019 [10]	Simple Shear	60	3:00	10:1	Oven	UNS mixing, vacuum degas 2 hr
Brown 2005 [11]	Tension	60	20:00	10-50:1	Oven	UNS mixing, vacuum degas 30 min
Fuard 2008 [12]	Tension	100	1:30, 2:00	variable	Oven	UNS
Johnston 2014 [13]	Tension†	25-200	variable	10:1	Oven	Flocculator, degas 30 min
Khanafer 2008 [14]	Tension	65	12:00	6-10:1	Oven	UNS mixing, vacuum degas >2 hr
Kim 2011 [15]	Tension			5-15:1	UNS	UNS
Liu 2009 [16]	Tension†	100 or 200	variable	10:1	Hot plate	UNS
Mills 2008 [17]	Tension‡	150	12:00	10:1	UNS	UNS
Moučka 2021 [18]	Tension†	25-150	variable	10:1, Si Oil	UNS	Vacuum mixer 100 RPM 10 min
Schneider 2008 [19]	Tension	150	0:15	10:1	Oven	Hand mix 6 min, degas
Seghir 2015 [20]	Tension	10 or 160	2:00, 144:00	variable	Hot plate	UNS with 5 low vacuum cycles
Upadhyay 2021 [21]	Tension	60	3:00	10:1	Oven	UNS mixing, vacuum degas 2 hr
Wang 2019 [22]	Tension	65	4:00	10-30:1	Oven	Planetary mixer, vacuum degas
Wang 2014 [23]	Compression	65	12:00	5-33:1	Oven	UNS mixing, vacuum degas
Carrillo 2005 [24]	Compression & Nanoindentation	25	336:00	10-30:1	RT	UNS mixing 10 min
Cao 2005 [25]	Nanoindentation	70	24:00	10:1	Hot plate	UNS
Cheng 2011 [26]	Nanoindentation	65	1:30	10:1	Vacuum cure	UNS mixing 10 min, spin coated, vacuum
Gupta 2007 [27]	Nanoindentation	25	0:20, 2:40	variable	RT	UNS
Liao 2010 [28]	Nanoindentation	85	2:00	variable	UNS	UNS
Mata 2005 [29]	Nanoindentation	95	0:30	5.7-21:1	Oven	UNS mixing, spin coated
Patel 2019 [30]	Nanoindentation	70	5:00	10:1	UNS	UNS mixing, vacuum degas 30 min
Peng 2011 [31]	Nanoindentation	60	20:00	50:1	Oven	UNS mixing, vacuum degas
Armani 1999 [32]	Beam Bending	90	0:15	5-15:1	UNS	UNS
Du 2010 [33]	Beam Bending	65	1:30	10:1	Hot plate	UNS
Li 2024 [34]	Cylindrical Cavity Expansion	100	2:00	variable	Oven	Planetary mixer, vacuum degas 30 min
Thangawng 2007 [35]	Membrane	110	0:15	10:1	Hot plate	UNS, spin coated

4 Distribution of predictor variables

Spearman Correlations were chosen to describe the data for two main reasons: first, we wanted to to avoid imposing linearity in the relationship between the predictors (cure time, cure temperature, or mix ratio) and the resulting stiffness. Second, all three predictors are not normally distributed (rejecting the null hypothesis that the data are from a normally distributed population at a confidence level of $p < 0.05$ for the Kolmogorov-Smirnov test). Ordinal scale plots of the predictor variables are included in Fig. ESI.F2.

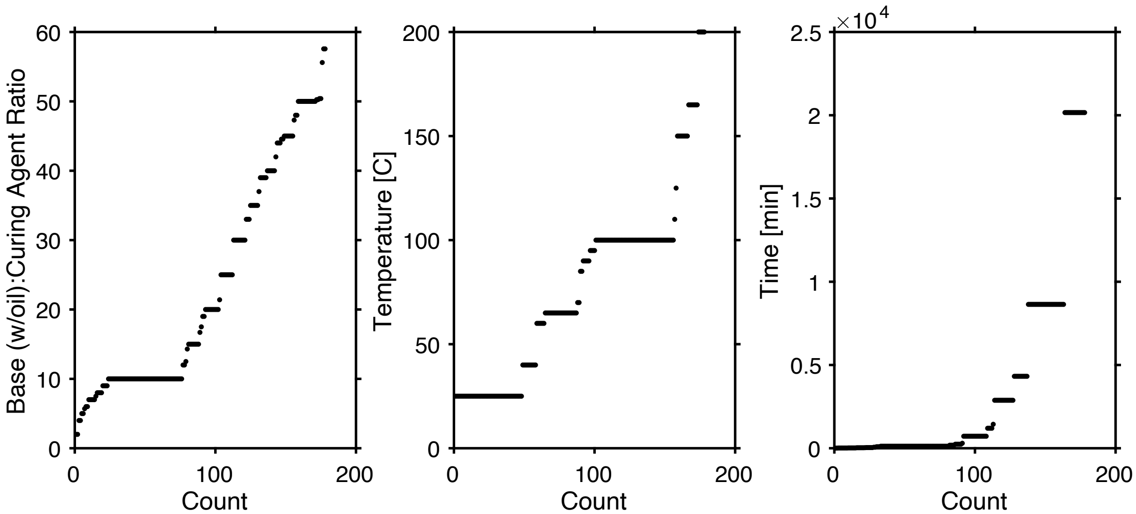

Fig. ESI.F2 Ordinal plot of predictor variables.

5 PDMS reaction chemistry

PDMS is formed from a base with bi-vinyl terminated -R^2Si-O- units combined with a curing agent containing S-H silane groups to form siloxane repeating units -Si-O- between cross links in the presence of a platinum catalyst[36–38]. The average molecular weight between cross links M_c is determined by the curing agent ratio, with the higher weight, and therefore longer, chains resulting in softer material. SYLGARD 184 is not pure PDMS, however the reaction pathway remains the same[36,39]. Schweitzer et al.[40] report M_c increases 3-6 fold between w_B:w_C of 10:1 and 20:1 with SYLGARD 184 (2400 to 7600 g/mol). Measuring five curing agent ratios between 10:1 and 25:1, the increasing M_c increases exponentially. This supports the nonlinear relation between μ and w_B:w_C observed in Fig. 2 given[41] $M_c \propto 1/\mu$.

6 Predictor variable contour plots

To visually examine the inter dependencies of the predictor variables, Fig. ESI.F3 shows the contour plots for the permutations of mix ratio, cure time and cure temperature. Contour plots were generated in MATLAB 2023b using the Curve Fitting Toolbox and linearly interpolated surfaces. Fig. ESI.F3(a) shows how the combined effects of higher cross linker concentration and hotter cure temperature lead to the stiffest material while Fig. ESI.F3(b) and (c) confirm that total cure time does not have a strong effect on shear modulus.

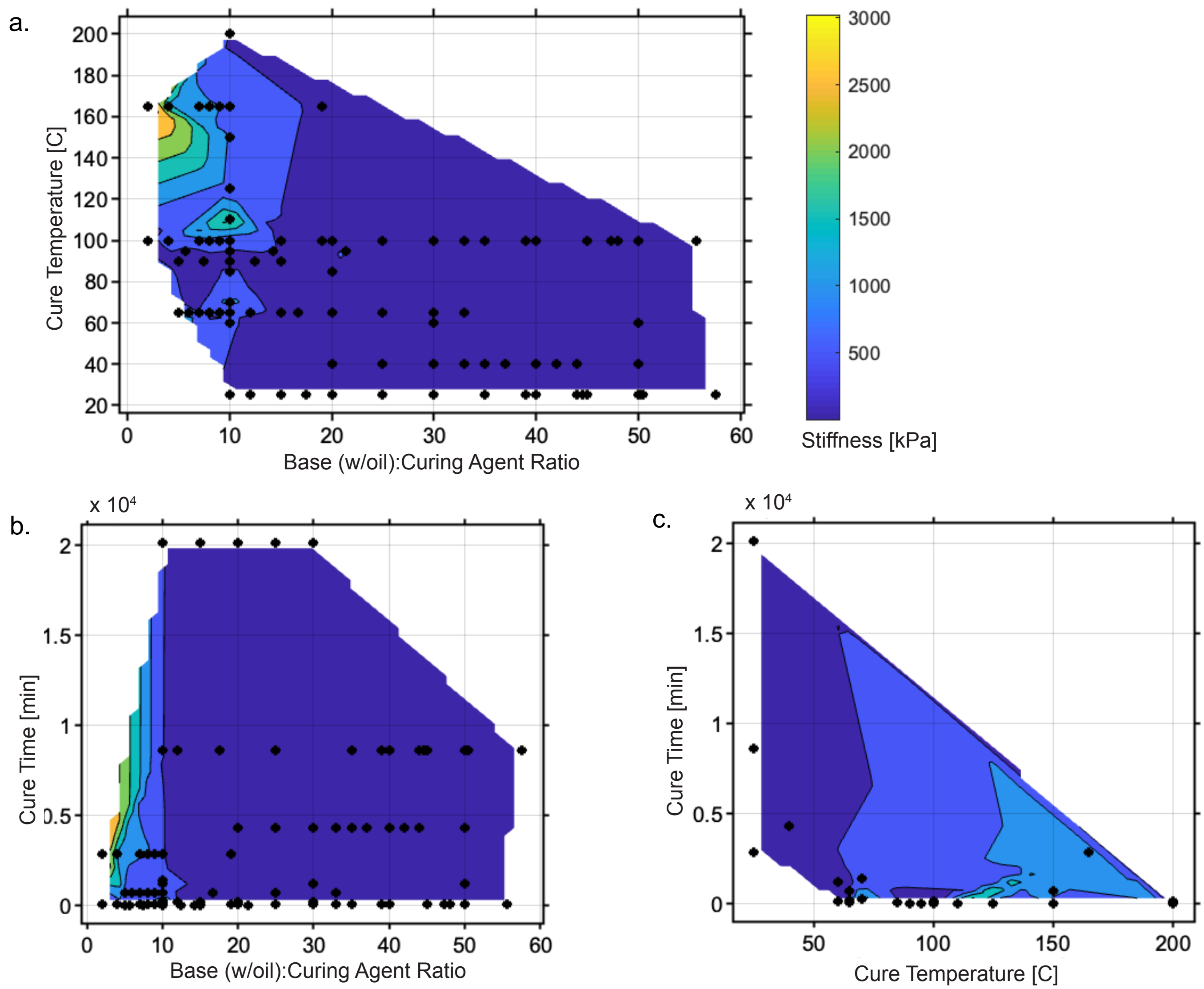

Fig. ESI.F3 Contour plots of the effect of mixing ratio, cure temperature and cure time on shear modulus. The effect of mixing ratio is seen to outweigh the effect of cure time. (a) compares the effect of mixing ratio and cure temperature on shear modulus with all points shown as black circles. Both predictors are seen to have an effect on the resulting stiffness. (b) compares cure time and mixing ratio while (c) compares cure time and temperature with mix ratio and temperature dominating over time, respectively.

Notes and references

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