

## A study into the ageing and dating of blue ball tip inks using in-situ visible spectroscopy with chemometrics

Georgina Sauzier<sup>a,b,\*</sup>, Jasmine McGann<sup>a,b</sup>, Simon W. Lewis<sup>a,b</sup> and Wilhelm van Bronswijk<sup>a</sup>

<sup>a</sup> School of Molecular and Life Sciences, Curtin University, GPO Box U1987, Perth, Western Australia, 6845, Australia.

<sup>b</sup> Curtin Institute of Functional Molecules and Interfaces, Curtin University, GPO Box U1987, Perth, Western Australia, 6845, Australia.

### Supplementary Information

All data associated with this work is available open-access via Research Data Australia;  
DOI: [10.4225/06/5b35e1f822c13](https://doi.org/10.4225/06/5b35e1f822c13)

**Table S1:** Models and assigned numeric identifiers for all pens in the sample population.

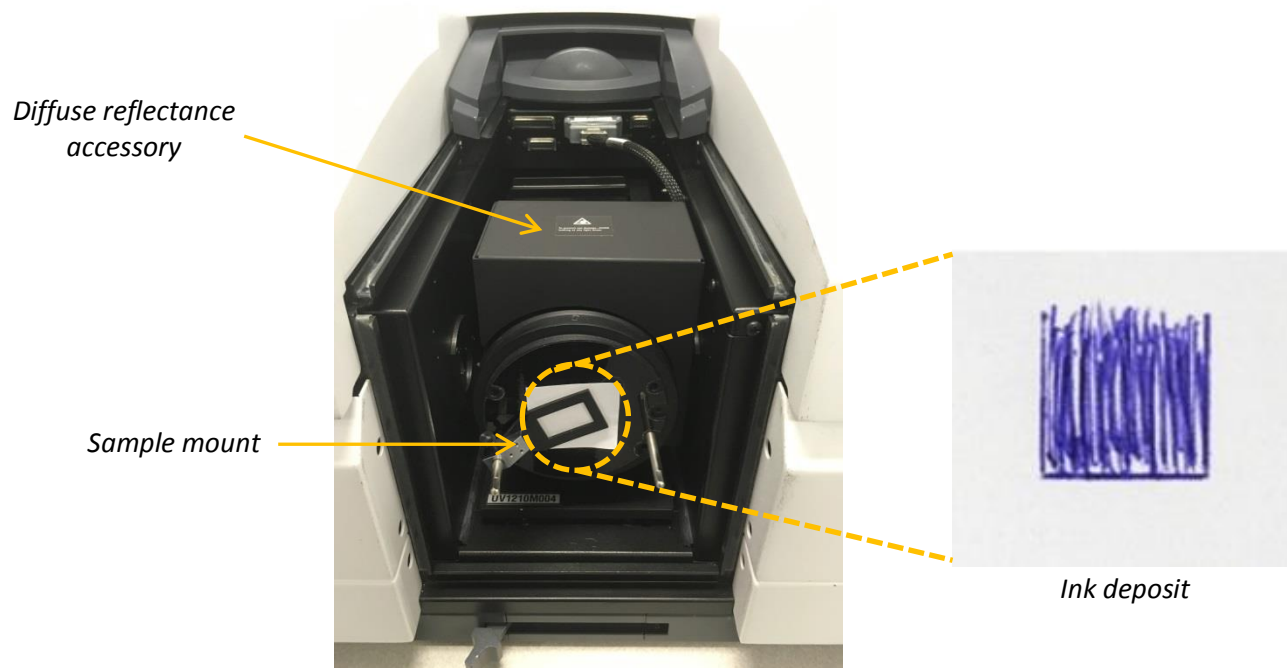
Pen ID	Pen Model	Pen ID	Pen Model
1	Bic Cristal	19†*	Pilot G-2 05
2	Papermate Ink Joy 100	20	Pilot Super Grip
3	Artline Ikonic	21	Uniball Power Tank
4	Deer Ultrafine	22	Pilot BPS-GP
5	Artline 7210	23†	PaperMate Profile
6	PaperMate Kilometrico	24	Bic Pro Plus
7	Bic ReAction	25	PaperMate FlexGrip Elite
8†	Celco Retractable	26†	Pentel Rolly
9	Bic Orange Fine	27	PaperMate Kilometrico Elite
10†	Keji Ballpoint	28	Staedtler Triplus 426
11†	Office Basics Ballpoint	29	Staedtler Stick Click Retractable
12	Artline Smoove	30	Pilot BP-145
13	J.Burrows Ballpoint	31	PaperMate FlexGrip Ultra
14	Bic Round Stic	32	PaperMate Ink Joy 300
15	Artline Flow 4-Colour Retractable	33	Office Choice Retractable
16	Artline Clix 4-Colour	34	COS Capped Ballpoint
17	Bic Cristal Easy Glide	35	Staedtler 430
18	Bic Economy		

(†) denotes inks selected for ageing and dating studies

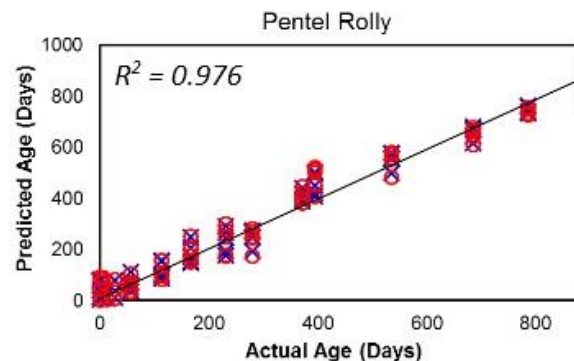
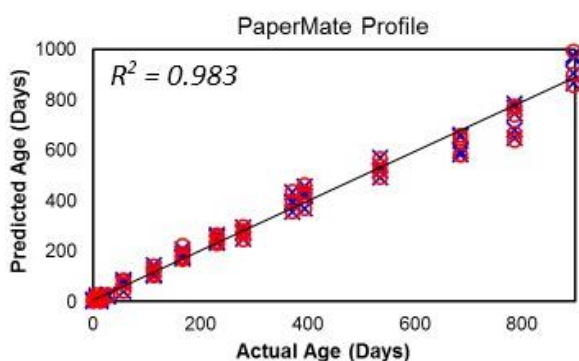
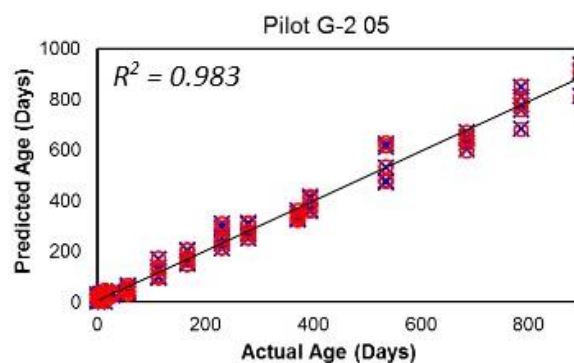
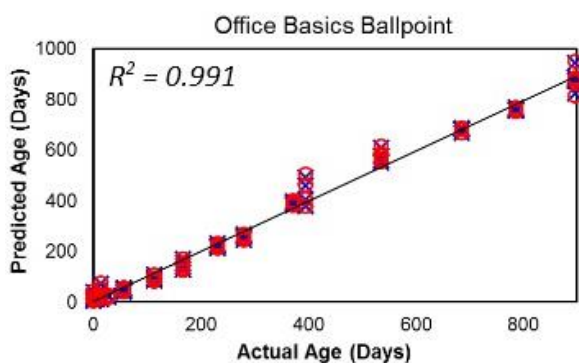
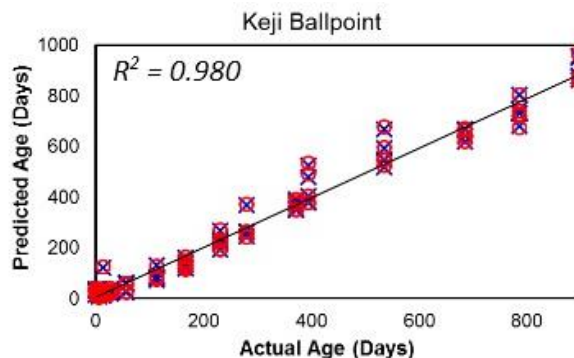
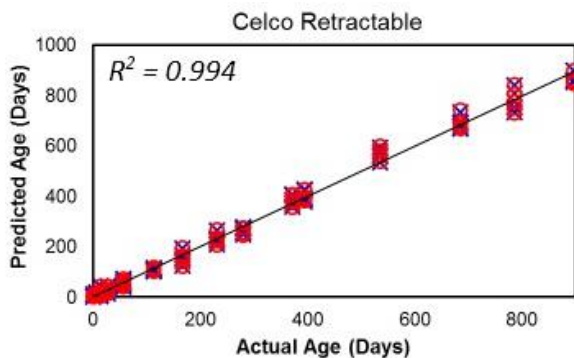
(\*) denotes a gel ink formulation

**Table S2:** Absolute and relative standard deviations associated with mean age estimations of validation ink deposits exposed to light. Values are averaged over five replicate spectra.

Actual Aging Period (Days)	Estimation Error (Days)											
	Pen 8		Pen 10		Pen 11		Pen 19		Pen 23		Pen 26	
	Std. Dev.	% RSD	Std. Dev.	% RSD	Std. Dev.	% RSD	Std. Dev.	% RSD	Std. Dev.	% RSD	Std. Dev.	% RSD
0 Day	7.9	16.8	18.2	137.9	7.0	28.0	7.9	119.7	16.3	111.6	22.4	147.4
6 Days	5.1	14.6	9.1	14.3	6.7	35.1	23.7	1247.4	17.6	119.7	15.4	132.8
21 Days	10.0	82.0	44.2	104.5	24.3	70.2	7.6	168.9	20.0	217.4	23.9	144.8
42 Days	7.7	192.5	29.7	48.1	7.5	17.0	28.9	74.1	27.6	58.6	50.2	116.7
98 Days	15.4	39.7	69.8	250.2	7.8	8.6	11.0	15.0	25.1	20.0	68.4	43.0
147 Days	16.5	17.8	53.4	702.6	8.8	6.5	19.3	15.4	30.3	18.5	26.0	12.6
504 Days	46.8	10.3	81.5	22.8	22.8	4.9	37.1	9.0	48.1	11.5	30.7	5.6
596 Days	204.9	47.4	99.8	24.0	28.9	5.7	19.1	4.4	72.3	15.7	33.7	6.2
617 Days	36.1	6.1	53.1	12.2	19.5	3.3	27.3	5.6	73.0	14.1	23.3	4.1
672 Days	26.1	4.1	82.4	16.1	33.5	5.4	31.9	5.8	48.5	8.2	23.4	3.8



**Figure S1:** Photographic image of (a) a prepared 25 mm x 25 mm ink deposit prepared for ageing studies; and (b) the instrumental set-up utilised for diffuse reflectance visible spectroscopy.



× Calibration ○ Cross-Validation

**Figure S2:** Reference values versus estimated values by PLSR models for the age estimation of six blue ball tip inks exposed to light over a 32-month period.