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Jones, Katie Louise

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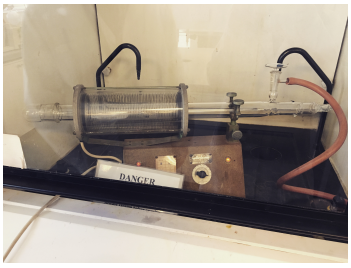
A multi-technique experimental and modelling study of the porous structure of IG-110 and IG-430 nuclear graphite.

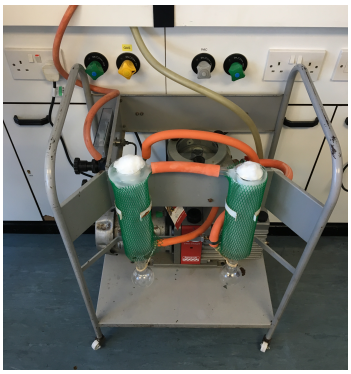
Katie L. Jones[a], Giuliano M. Laudone[a,*], G. Peter Matthews[a]

[a] *Faculty of Science and Engineering, Plymouth University, Plymouth, UK.*

Supplementary Information



(a)



(b)

Figure 1: Apparatus set-up to remove the residual mercury from the internal pore network of the IG-graphites; (a) vacuum pistol heated to 360°C (b) vacuum pump with liquid nitrogen trap, reaching pressures better than 0.13 Pa

*Corresponding author.
Email address: glaudone@plymouth.ac.uk (Giuliano M. Laudone)

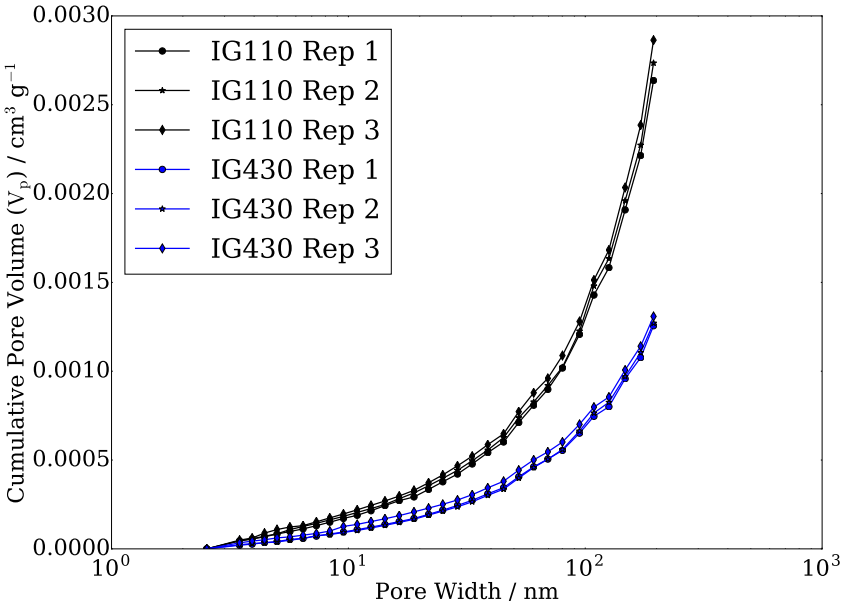


Figure 2: Cumulative PSDs obtained using BJH modelling simulations for IG-nuclear graphites

Table 1: Volumes of entrapped mercury present within the samples porous matrix during three key stages of the first mercury analysis: at maximum pressure during the first porosimetry run; after depressurisation and the sample has been removed from the instrument; and after thermal treatment after an attempt to remove all mercury from the porous sample; is given for IG-110 and IG-430 nuclear graphite.

Sample	Maximum Intrusion $/mm^3g^{-1}$	post depressurisation $/mm^3g^{-1}$	post thermal treatment $/mm^3g^{-1}$
IG-110	111.04	11.46	3.81
IG-430	93.14	85.42	4.91

Table 2: Sensitivity analysis performed for the five stochastic generations run for each graphite sample. The representative results for each graphite were those that had all five fitting parameters closest to the mean of those parameters, shown here in bold.

IG-110	Vertically banded Stochastic realisation number								
Parameter	1	2	3	4	5	Average	StDev	Lower limit	Upper limit
Pore skew	1.567444	1.33403	1.341179	**1.334031**	1.25763	1.3668628	0.117239285	1.249623515	1.484102085
Throat skew	4.479693	1.494558	21.789972	**1.494558**	19.78885	9.8095262	10.12178961	-0.312263406	19.93131581
Throat spread	0.54661625	0.613680406	0.65985225	**0.61368**	0.477166	0.582198981	0.071256969	0.510942012	0.653455951
Connectivity	5.51198175	5.3858	5.00083225	**5.3858**	3.707256	4.998334	0.746823683	4.251510317	5.745157683
Correlation level	0.07721075	0.016383594	0.0028295	**0.016384**	0.01352	0.025265569	0.029569449	-0.00430388	0.054835017
Distance(%)	1.29	1.27	1.29	1.26	1.38	1.298	0.047644517	1.250355483	1.345644517

IG-430	Vertically banded Stochastic realisation number								
Parameter	1	2	3	4	5	Average	StDev	Lower limit	Upper limit
Pore skew	1.308356	1.561367	**1.179774**	1.989441	1.091996	1.4261868	0.361184107	1.065002693	1.787370907
Throat skew	17.368598	3.382969	**5.230064**	0.811751	10.983338	7.555344	6.639706012	0.915637988	14.19505001
Throat spread	0.412527	0.599237	**0.57608175**	0.58638	0.533637	0.54157255	0.076222549	0.465350001	0.617795099
Connectivity	3.365559	5.06938	**5.306793375**	5.412755	4.933736	4.817644675	0.833490166	3.984154509	5.651134841
Correlation level	0.180591	0.02634	**0.04887325**	0.023677	0.069206	0.06973745	0.064670338	0.005067112	0.134407788
Distance(%)	1.2	1.35	**1.16**	1.27	1.18	1.232	0.077910205	1.154089795	1.309910205

Table 3: Calculations to explain the apparent intrusion of graphite by mercury at high pressures

	Graphite results	Units
Modulus of elasticity	12.925	$\mathrm{GN\,m^{-2}}$
Modulus of elasticity	1.29×10^{10}	$\mathrm{N\,m^{-2}}$
Max intrusion pressure (stress)	400	MPa
Max intrusion pressure (stress)	400000000	Pa
Resulting strain	0.030945	
Assumed size of cubic sample	0.005	m
Original volume of sample	0.000000125	$\mathrm{m^3}$
Final volume of sample	1.1375E-07	$\mathrm{m^3}$
Apparent intrusion	1.125E-08	$\mathrm{m^3}$
Apparent intrusion	11.25	$\mathrm{mm^3}$
Sample Density	1.8	$\mathrm{g\,cm^{-3}}$
Sample Density	1800000	$\mathrm{g\,m^{-3}}$
Sample weight	0.225	g
Intrusion volume	**49.99**	$\mathrm{mm^3 g^{-1}}$