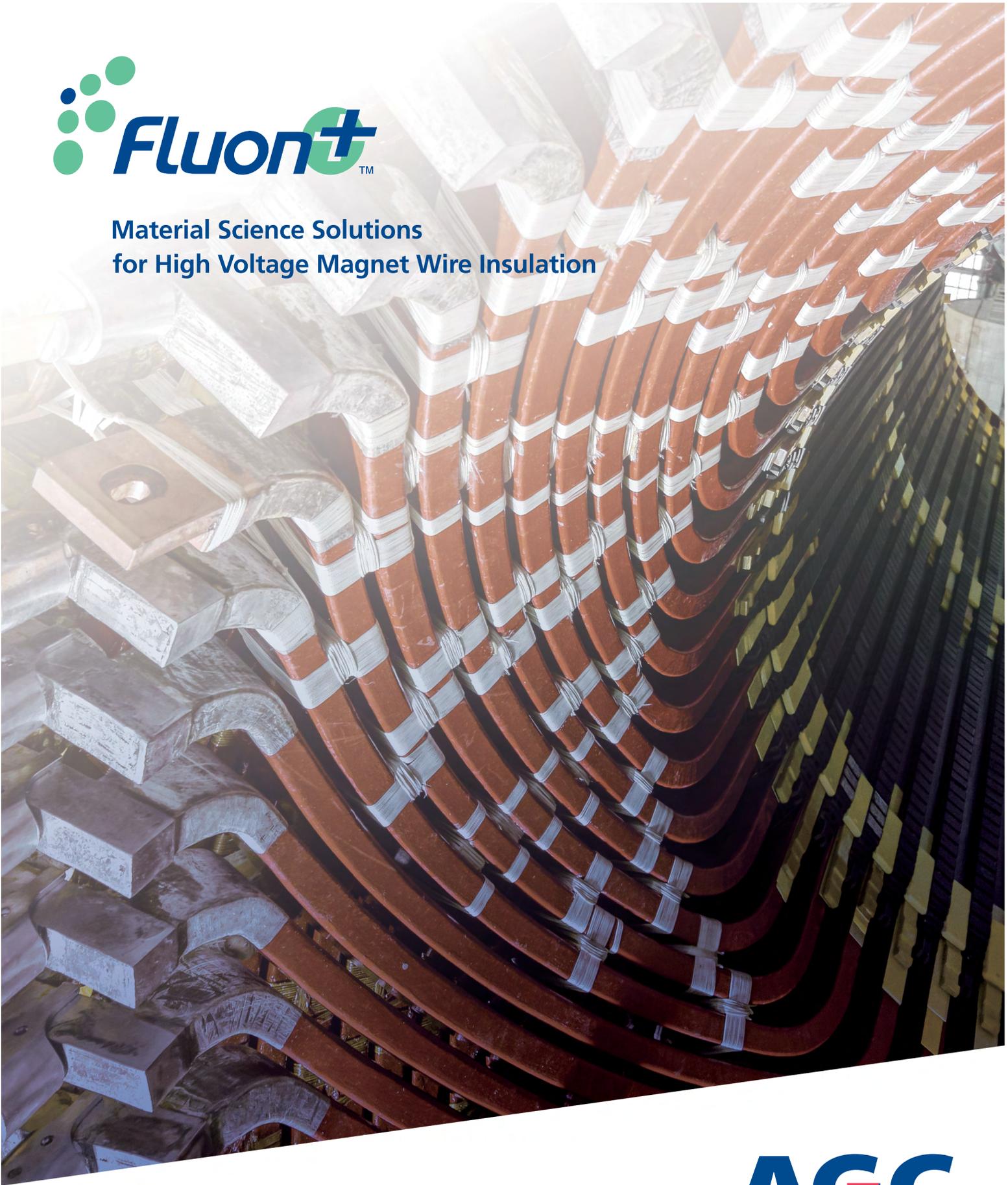




**Material Science Solutions
for High Voltage Magnet Wire Insulation**



Your Dreams, Our Challenge



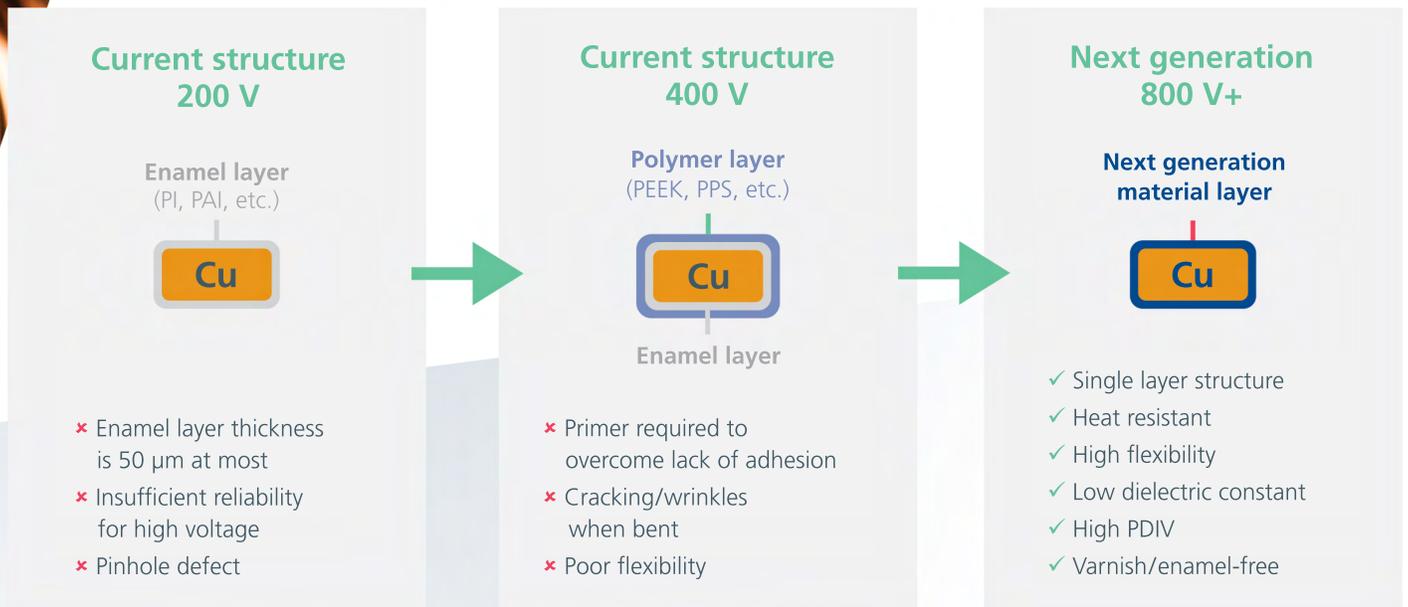
Magnet Wire Insulation Materials

The efficiency of electric motors in EVs has been advancing rapidly with the aim of reducing environmental impact of traditional vehicles.

At present, electric and plug-in vehicles use inverter drive motors with ratings between 200 – 400 V. Demand for voltage continues to climb, and some current models require 800 V and higher for increased range, improved charging speeds, and heavy duty EV motors.

Wire Insulation

The varied wiring geometries demand new materials for wire insulation. Existing material solutions used in current constructions are not reliable enough for high voltage due to thickness limitations, potential pinhole defects, and cracking from poor adhesion.



Why you need next generation compounds with higher partial discharge inception voltage (PDIV)

Instantaneous voltage during sudden braking and sudden acceleration is 2 to 3 times the normal voltage. For a 400 V motor, instantaneous voltage is within PDIV, so no partial discharge occurs. For a 800 V motor, instantaneous voltage exceeds PDIV, and the generated inverter surge invades into winding wires and parts.



	PDIV/V
PI enamel	800~900
PI enamel + PEEK layer	1400
New criteria	> 1500

Fluon+ PFA Compound Solutions

High flexibility and adhesion to polyimide and copper without losing the outstanding insulation and thermal properties of neat PFA.

Fluon+ PEEK Compound Solutions

Improved flexibility, impact strength, and electrical performance compared to neat PEEK.

Fluon+ ETFE Compound Solutions

Offers a balance of properties over a range of operating conditions.

Fluon+ PPS Compound Solutions

Improved electrical properties and flexibility for less demanding wire applications.

Figure 1:

Qualitative comparison of AGC magnet wire insulation materials

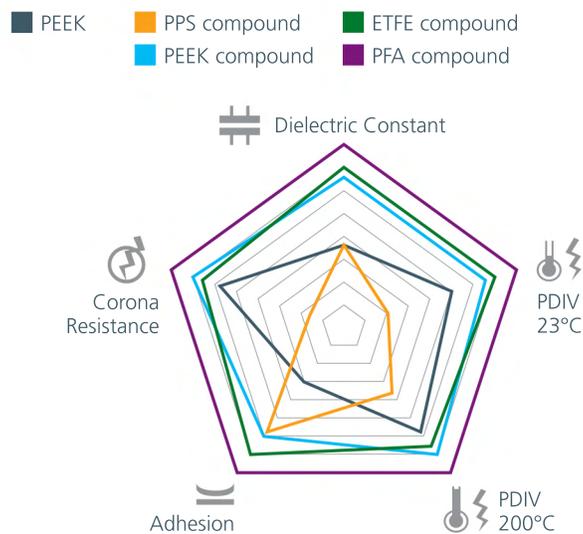
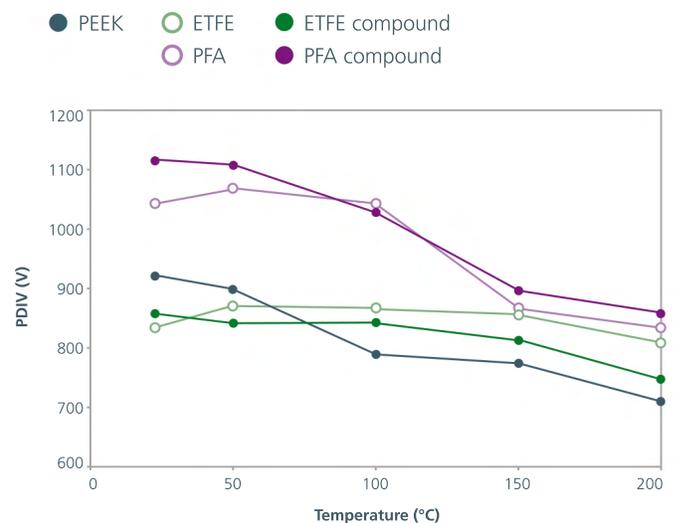


Figure 2:

Partial discharge inception voltage of 100 μm film samples at different temperatures. PDIV threshold was 100 pC.



Property	Unit	Test Method	PFA			PEEK		ETFE			PPS	
			Neat PFA	PA-1030	PA-2020	Neat PEEK	KA-2030	C-88AXMP HT	AH-800	FP-E-93000XL	Neat PPS	SB-1331
Melt Temperature	°C	DSC	310	302	300	341	340	254	250	260	280	280
Specific Gravity			2.1	2.1	2.1	1.3	1.5	1.7	1.7	1.8	1.4	1.4
Melt Flow Rate, 5 kg	g/10 min	ASTM D3159	30	27	45	22	28	30	30	16	44.4	34.2
			@ 372 °C			@ 380 °C		@ 297 °C			@ 297 °C	
Tensile Strength	MPa	ASTM D638	32	22	17	97	81	52	50	48	51	43
Tensile Elongation	%	ASTM D638	410	260	330	140	110	550	500	415	14	24
Flex Modulus	MPa	ASTM D790	380	390	415	3060	2300	870	820	400	3500	2400
Adhesion to Untreated Copper Wire		ASTM D1676	Fail	Pass	Pass	Fail	Pass	Fail	Pass	Pass	Fail	Pass
Temperature Class		IEC 60172	Under evaluation									
Corona Resistance	hr		Under evaluation									

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