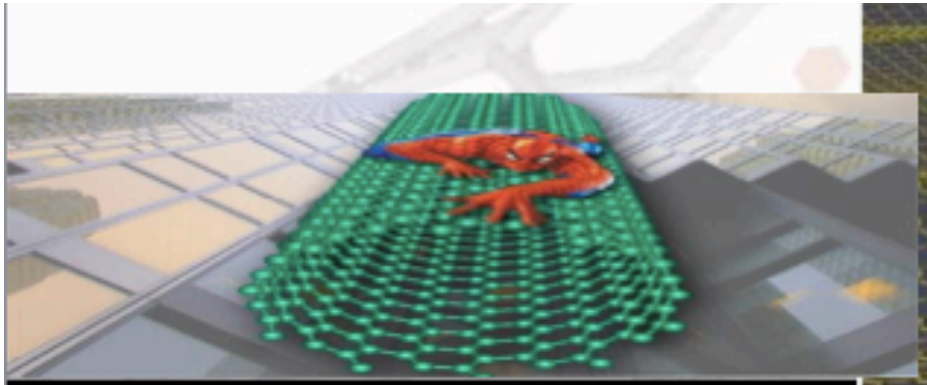
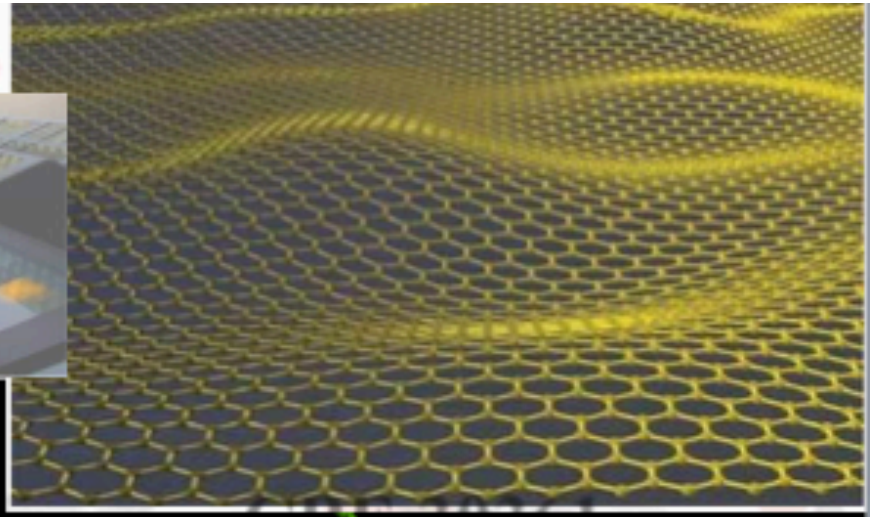
Fundusze Europejskie
Wiedza Edukacja Rozwój

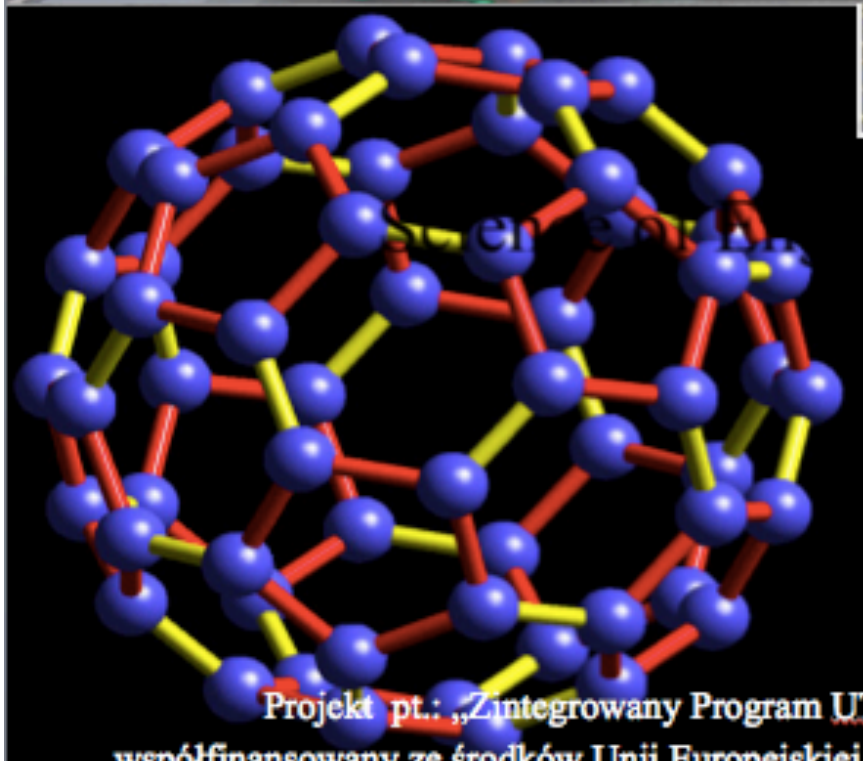
Rzeczpospolita Polska

UNIWERSYTET TECHNOLOGICZNO-HUMANISTYCZNY
im. Kazimierza Pułaskiego w Radomiu

Unia Europejska
Europejski Fundusz Społeczny







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Course Number:1

Course Title: Science of Engineering Materials

Lecture №09

Carbon-carbon composite materials.

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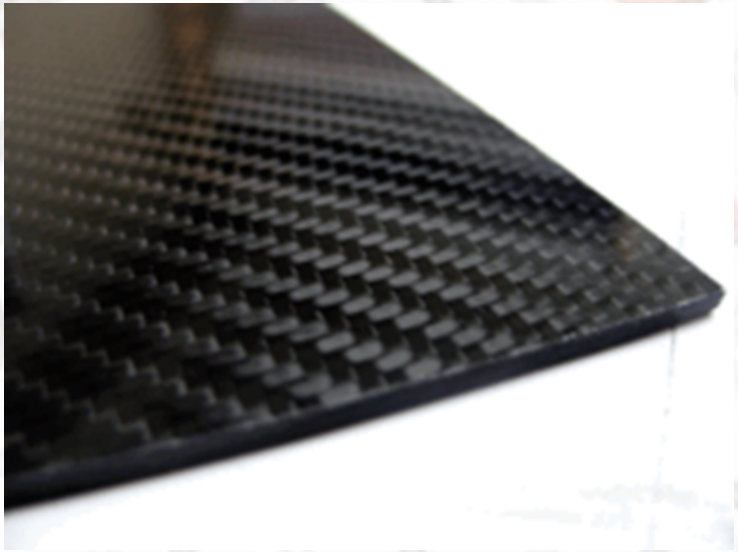
The advantages of the CCCM: low density (1.3 - 2.1 t / m3); high heat capacity, resistance to thermal shock, erosion and radiation; low friction and linear expansion coefficients; high corrosion resistance; a wide range of electrical properties (from conductors to semiconductors); high strength and stiffness.

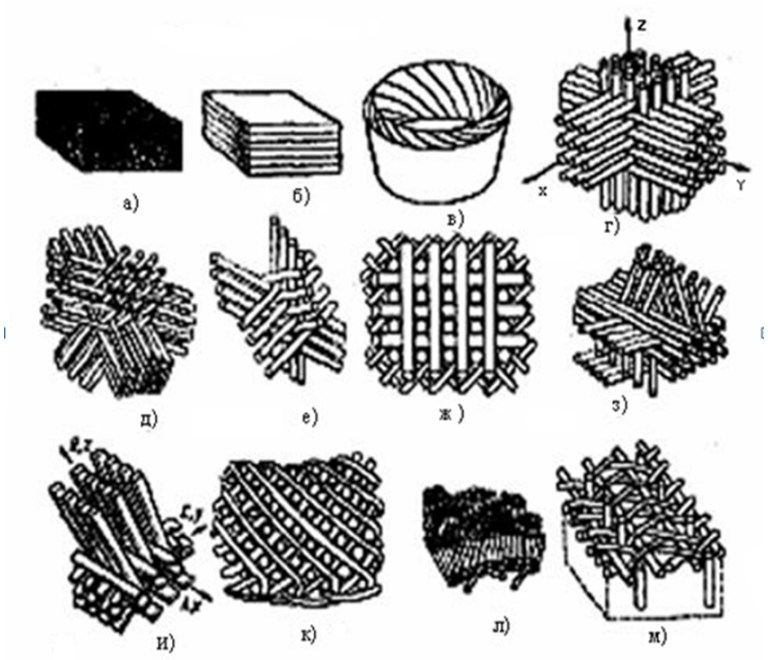
Carbon fiber sheet



The special properties of CCCM include low porosity, low thermal expansion coefficient, maintaining a stable structure and properties, as well as the dimensions of products during heating to 2000 ºC and cooling, high mechanical properties (graph 1, table 4), as well as good electrical conductivity. The main application of the CCC is found in products that operate at temperatures above 1200 ºC.

The specificity of using the properties of the CCCM is associated with a number of unique features inherent in the class of carbon materials. The presence of fibrous filler in the volume of the CCCM makes the level of their physico-mechanical properties unattainable for traditional carbon materials. The variation in the spatial arrangement of the fibrous filler of the composite is an effective tool in controlling the anisotropy of the CCCM properties.

Location of carbon fibers in the CCCM



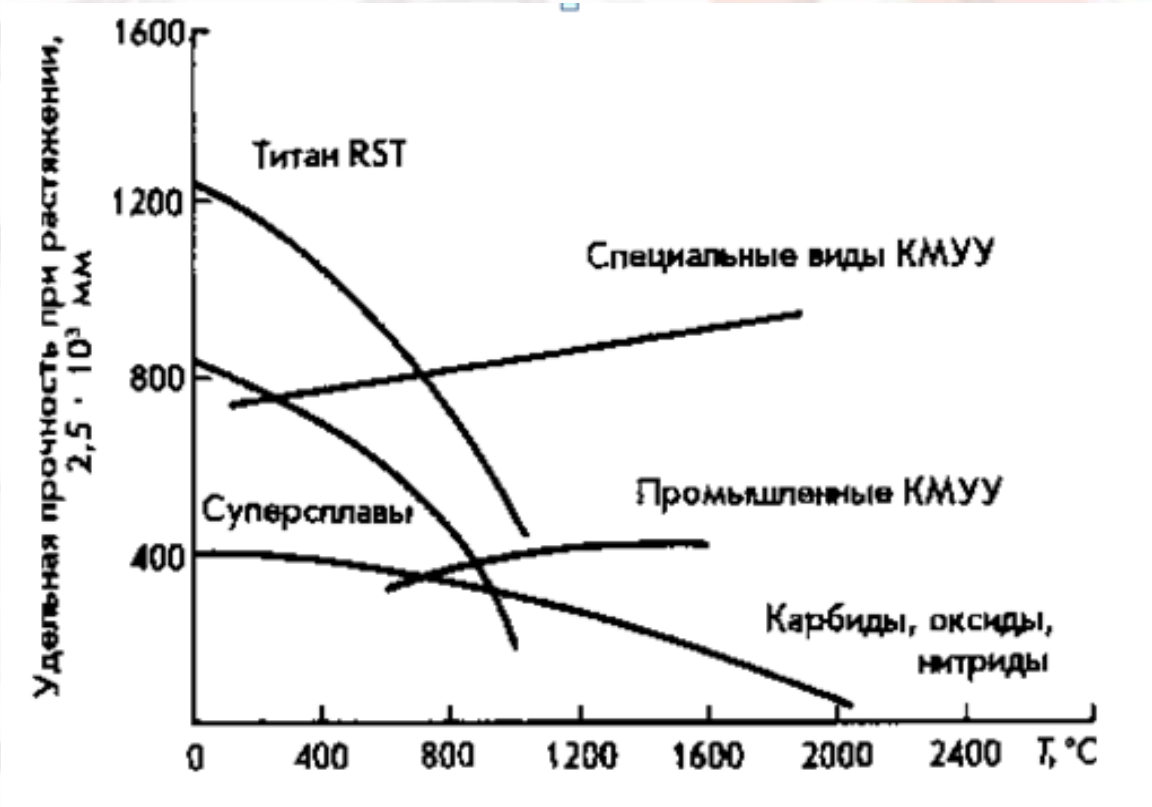
Carbon-carbon composite properties

Тип волокна	d, мкм	ρ, кг/м^3	σ, МПа (разрыв)	$\acute{L}_{\acute{o}}$, ГПа
Высокомодульное	8,3	2000	2100	413
Высокопрочное	7,7	1800	2400÷3200	240÷290
С повышенным удлинением	6,9÷7,4	1750	2300÷2900	170÷200

Carbon –carbon composites properties

Характеристика	Отечественные УУКМ		Зарубежные аналоги			
	А	Б	Sekarb-SOO	Sekarb-SF	Aerolor-32	Aerolor-33
Тип каркаса	3D	4D	4D	4D	3D	3D
Плотность, г/см^3	1,91	1,91	1,87	2,0	1,93	1,85
Прочность при растяжении, МПа	113	110,0	-	130,0	170,0	80,0
Модуль упругости, ГПа	52,5	50,0	-	62,0	-	-
Прочность при сжатии, МПа	145	140,0	95,0	115,0	130,0	100,0
Коэффициент теплопроводности, Âň/ĕ ·K	61,0	54,00	100,0	180,0	150,0	200,0
ТКЛР, K^{-1}	$3,4\cdot10^{-6}$	$3,0\cdot10^{-6}$	$1,5\cdot10^{-6}$	$4,0\cdot10^{-6}$	-	-
Диаметр, мм: заготовки стержней	410 1,2	-	500 1,0÷1,8	500 -	- 1,6	- 1,2
Температура обработки, °С	-	-	3000	-	2700	1950

Temperature dependence of the specific tensile strength



Carbon-Carbon composite