INVESTIGATION OF ELECTRODYNAMIC CHARACTERISTICS OF MATERIALS AIN-Y_2O_3-C BASED AT FREQUENCIES 30-67 GHZ

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EXPERIMENTAL METHODOLOGY

TECHNOLOGICAL SCHEME OF OBTAINING THE COMPOSITE MATERIAL BASED ON ALN-Y_2O_3-DIAMOND

BATCH
AIN-Y2O3-(1-5)% Diamond

↓

GROUND OF BATCHES

↓

COMPACTING OF SAMPLES

↓

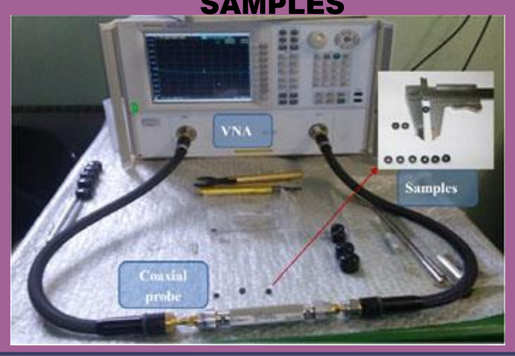
SINTERING OF COMPOSITES

before 1850 ºC

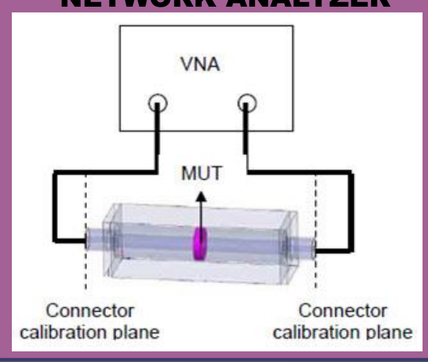
THE STRUCTURE OF THE SAMPLES WAS STUDIED BY THE METHODS:
- THE X-RAY PHASE AND STRUCTURAL ANALYZES (DRON-3M IN CUKA-RADIATION WITH NI-FILTER);
-THE RIETVELD;
- THE SCANNING ELECTRON MICROSCOPY USING SEM ZEISS EVO 50XVP, JXA 88002 USING MICRO-X-RAY SPECTRAL ANALYSIS.

ELECTRODYNAMIC CHARACTERISTICS WERE MEASURED USING A VECTOR ANALYZER NETWORK KEYSIGHT TECHNOLOGIES PNA N5227A \ N5227 10MHZ – 67 GHZ.

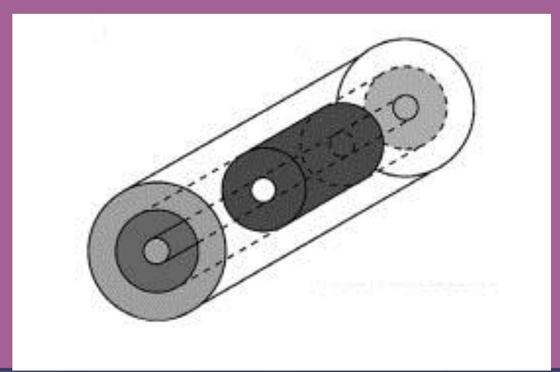
VECTOR ANALYZER KEYSIGHT TECHNOLOGIES PNA N5227A \ N5227 10MHZ – 67GHZ NETWORK WITH SAMPLES



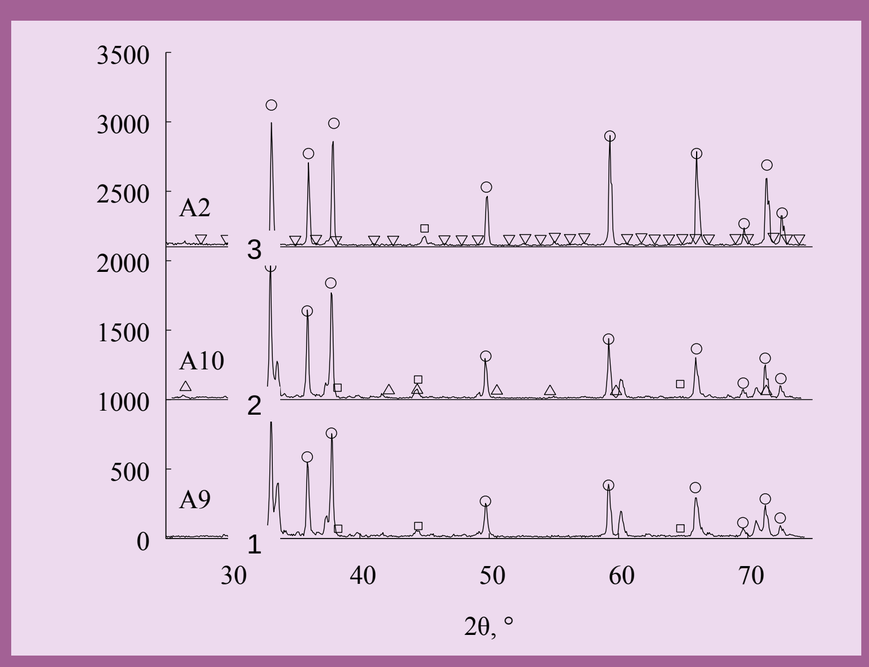
BLOCK SCHEME OF ELECTRODYNAMICS MEASUREMENTS CHARACTERISTICS OF MATERIALS BY THE NETWORK ANALYZER



SCHEMATIC IMAGE OF COAXIAL CELL WITH A SAMPLE OF CERAMICS

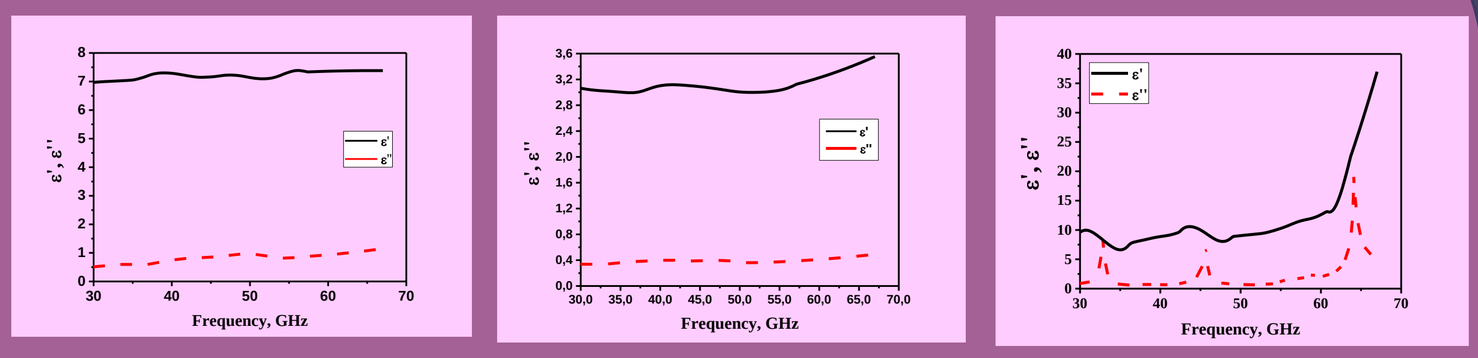


RESULTS



THE PHASE COMPOSITION OF COMPOSITE MATERIALS BASED ON ALN-Y_2O_3-C,%: CURVE 1-5; CURVE 2 - 3; CURVE 3 - 1, WHERE ● - ALN_H, ■ - ALN_C, ▲ -C, ▼ - $Y_3AL_5O_{12}$

ELECTRODYNAMIC PROPERTIES OF COMPOSITE MATERIALS BASED ON AIN-Y_2O_3-DIAMOND

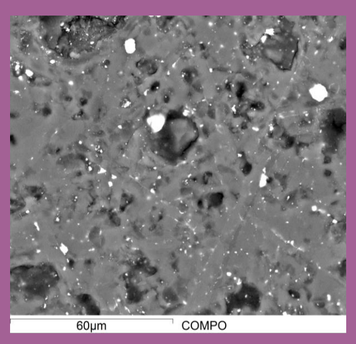


THE SPECTRAL DEPENDENCES OF THE REAL AND IMAGINARY PART OF THE DIELECTRIC CONSTANT (AT FREQUENCIES 30-70 GHZ) OF CERAMICS BASED ON ALN WITH DIAMOND (A) – 1%, (B) -3%, (C)-5%.

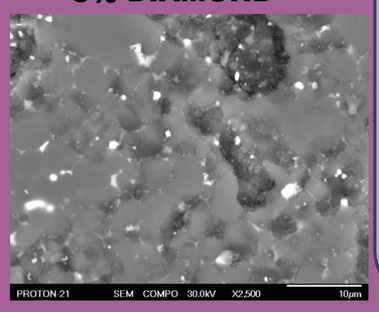
LATTICE PERIODS AND COMPOSITION OF COMPOSITES, BASED ON ALN-Y_2O_3-DIAMOND, DETERMINED BY THE RIETVELD METHOD

№ OF SAMPLE	CONTENTS DIAMOND IN COMPOSITES, %	PHASE	PERIODS OF THE CRYSTAL LATTICE, nm	
			a	*c*
1	1	AlN_h	0,311	0,498
		AlN_c	0,407	-
		$Y_3Al_5O_{12}$	-	-
		C	-	-
2	3	AlN_h	0,311	0,497
		AlN_c	0,407	-
		$Y_3Al_5O_{12}$	-	-
		C	0,247	0,671
3	5	AlN_h	0,311	0,498
		AlN_c	0,403	-
		$Y_3Al_5O_{12}$	1,201	-
		C	0,247	0,671

1% DIAMOND



5% DIAMOND



The increasing the diamond impurity from 1 to 3 % Reduces the actual part of the dielectric constant from 7 to ≈3. A further increase in the diamond content to 5 % leads to an increase in the value of ε ' due to the greater amount of C in the structure.

THE MAIN CHARACTERISTICS OF COMPOSITES BASED ON ALN-Y_2O_3-C (DIAMOND)

SAMPLE	CONTENTS DIAMOND IN COMPOSITES, %	DENSITY, g / cm3	tgδ
1	1	3,16	0,09
2	3	3,16	0,06
3	5	3,14	0,13-0,2

CONCLUSION It is likely that increasing the of carbon concentration in the structure of the material that was formed during the sintering of diamond particles leads to the formation of the conductive phase areas due to the accumulation of carbon inclusions. The electromagnetic wave that propagates in the sample at certain frequencies resonates in the structure with carbon particles, due to formation of these electrically conducting regions.
Despite this, the results obtained indicate that theses ceramics can be used in microwave electronics, in particular for the Internet (5G).