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Bulk nanocrystalline iron alloy

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The subject of the invention is a massive nanocrystalline iron alloy classified as magnetically soft, which can be used in electronics, electrical engineering and energy and in particular as: high power transformers for switched mode power supply systems, high accuracy current transformers for energy meters or impulse transformers for communication.

The massive fast-cooled nanocrystalline alloy according to the invention, the main component of which is iron, is characterized in that Si (Si: 0.25 or 0.5 or 0.75 or 1%) was introduced as a structure stabilizer. Increasing the Si content blocks the growth of Fe phase and borides by limiting the diffusion of atoms over further distances.

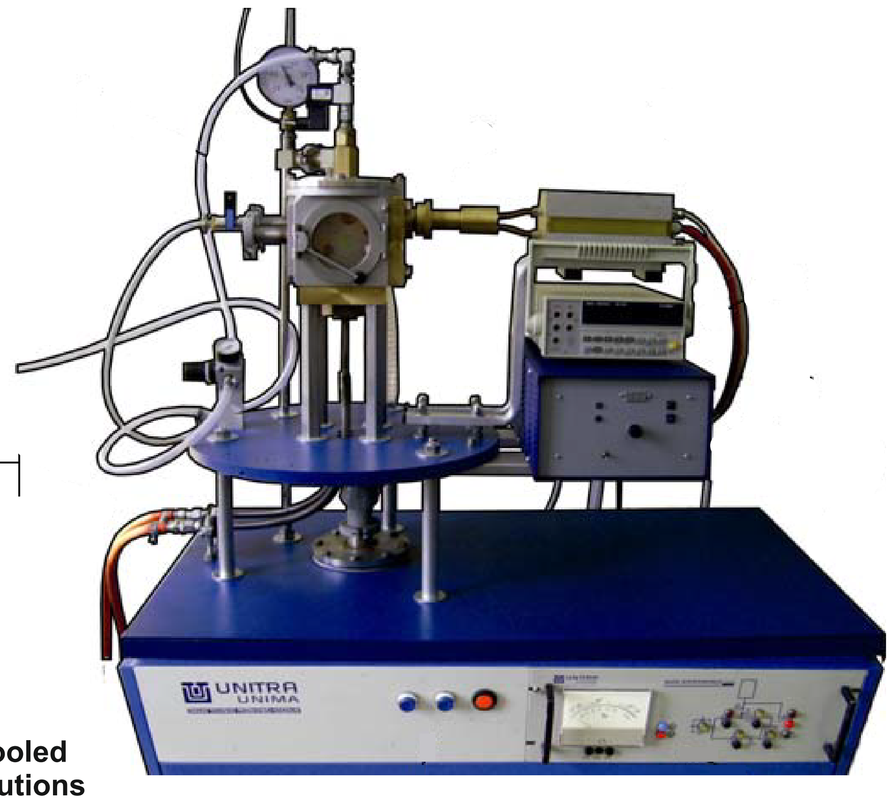
The massive nanocrystalline alloy was produced in one production step, which means that it was not subjected to additional processing enabling its nanocrystallization. In the casting process it was cooled at a speed of about 102 K / s, which at this speed causes a significant relaxation of structure and gives the alloy the expected properties. The Fe65Co11-xB20SixZr2Hf2 alloy material according to the invention contains (atomically) respectively: Fe - 65%; B - 20%; Zr - 2%; Si - from 0.25% - to 1%; Co - from 10% to 10.75%, Hf - 2% when meeting the Co11-xSix relationship (where x = 0.25 or 0.5 or 0.75 or 1) with permissible contamination not more than 0.09%.

The advantage of the proposed alloy according to the invention is also that in relation to the produced amorphous materials of thin alloy strips they can be made in one production stage with a thickness of 0.5 mm while maintaining a low coercive field value, high saturation induction and good temperature stability.

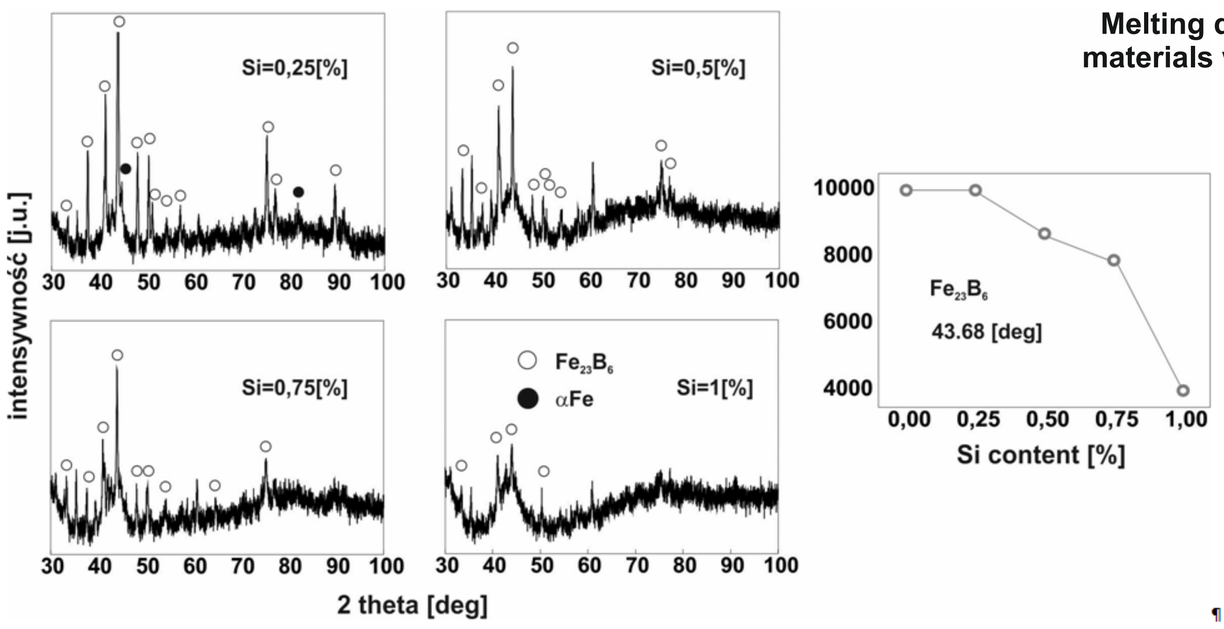
MODERN ALLOYS FOR SPECIAL APPLICATIONS. THE SOLUTION HAS VERY GOOD OPINIONS ABOUT INNOVATION

Patent application No. P.432728

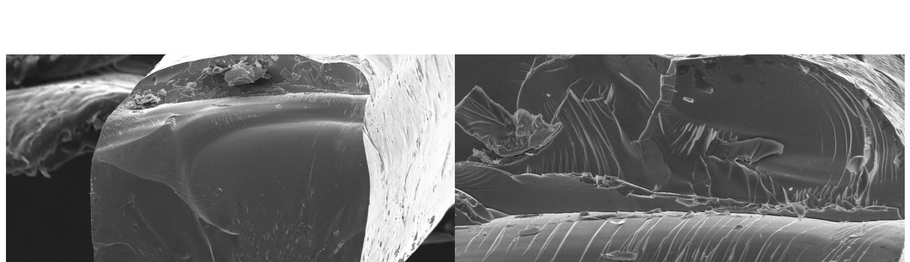
	Alloy	H_C [A/m]	M_S [T]	D_{spf} [meV/nm^2]	T_C [K]
Pattern	$Fe_{65}Co_{11}B_{20}Zr_2Hf_2$	310	1.43	46	690
Sample I	$Fe_{65}Co_{10.75}B_{20}Si_{0.25}Zr_2Hf_2$	143	1.40	45	672
Sample II	$Fe_{65}Co_{10.5}B_{20}Si_{0.5}Zr_2Hf_2$	56	1.40	43	668
Sample d III	$Fe_{65}Co_{10.25}B_{20}Si_{0.75}Zr_2Hf_2$	62	1.38	43	663
Sample IV	$Fe_{65}Co_{10}B_{20}Si_1Zr_2Hf_2$	61	1.37	43	655



Melting device for quickly cooled materials with the applied solutions



A nanocrystalline massive iron alloy characterized in that it has the atomic composition of Fe65Co11-xB20SixZr2Hf2, where the value of x is 0.25 or 0.5 or 0.75 or 1, and the permissible amount of impurities does not exceed 0.09%.



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