1. Project Proposal Information

Project Proposal Title	Formatıon of phase composıtıon and structure ın nanodımensıonal fılms on base of $CoSb_3$ skutterudıte – functıonal elements of thermoelectrıcıty
Project Proposal Acronym	
Call Identifier	FP7-NMP-2012-CSA-6 FP7-NMP-2012-SME-6 FP7-NMP-2012-LARGE-6 FP7-NMP-2012-SMALL-6
Topic(s)	NMP.2012.2.2-2 Materials for data storage
Funding Scheme	Small or medium-sized collaborative projects
Keywords	nanodimensional magnetic and thermoelectric film, silicide film
Abstract (Max. 2000 words)	Thermoelectrics is priority direction of development of science and technique based on the direct conversion of thermal energy into electric. Absence of moving parts and possibility of functioning in extreme conditions provide a high reliability and practically unlimited resource of work to the thermoelectric energy sources. The special advantage is using the thermal energy that is lost. For this reason such sources are founded wide application in space, in a military technique and in the way of life.
Project Description (Main Work Packages)	The conversion efficiency is determined by dimensionless figure of merit $$ZT=S^2 \sigma T/(k_e+ k_l),$$ where σ is thermal conductivity, ***S*** is Seebeck coefficient, ***T*** is temperature, k_e is the carrier thermal conductivity, k_l is the lattice thermal conductivity). In spite of active attempts to get material with the high value of ***ZT*** nowaday thermoelectric elements which in majorities are synthesized by the methods of powder metallurgy have ***ZT*** which does not exceed 1. In the nanodimensional film state ***ZT,*** as theoretical calculations

	show, can have value ≥ 2. It is explained that at transition to nanodimensions the electron-phonon interaction decreases and a phonon subsystem, being adiabatically isolated, does not almost accept participating in the transfer of heat from a heater to the cooler. Therefore nanostructuring of thermoelectric materials is effective technology to achieve a high ***ZT*** due to achievement of low thermal conductivity. It is suggested to use the nanodimensional $CoSb_3$ – based skutterudite film as thermoelectric material with high-performance thermoelectric properties. A lattice thermal conductivity can be considerably reduced due to decrease of size of grains that results in additional scattering of phonons on the grain boundaries, and also presence of pores in films. One of the special properties of skutterudite compounds there is also possibility of decrease of lattice thermal conductivity when small in size atoms fill pores in the crystalline structure of skutterudite. Alloying atoms (filler of pores), for example, the atoms of elements of Ba, Yb, Tl, Ce, La, at resonance frequency additionally scatter heat, what is carried by phonons, that results in the lower thermal conductivity of film. Due to it thermoelectric efficiency of ***ZT*** can attain the value more than 1,4. Nanodimensional $CoSb_3/SiO_2$(100 nm)/Si(001) film compositions of nanometer (10 – 50 nm) thickness will be obtained by co-deposition of Co and Sb in vacuum of 10^{-9} Pa on substrates of monocrystalline Si(001) covered SiO_2 layer at room temperature or heated to temperature in the range (370 – 570)K. Sb deposition will be carried out by effuser and Co – by electron-beam methods. For alloying of film it will be used Ba, Yb, Tl, Ce, La. For thermal treatment it will be applied annealing in nitrogen or vacuum in temperature range of (570 - 970)K.
Current Consortium (Partners, Organisation Types)	No

Deadline for Responses	November 2011, January 2012

2. Profile of the Partners Sought

Organisation Type	Research or Educational
Required Skills and Expertise	nanodimensional magnetic and thermoelectric film, silicide film
Role in the project	Cooperation in investigations
Other Requirements	

3. Project Proposer Information

Name of the Organisation	National Technical University of Ukraine “Kiev Polytechnic Institute”
Organisation Type	Education
Country	Ukraine
Fields of Activity	nanodimensional magnetic and thermoelectric film, silicide film
Contact Person	Makogon Yuriy
Position in the Organisation	Professor Metal Physic Department
Tel	+38 (044) 406 82 18, +38 068 8060763, +38 044 454 91 99
Email	y.makogon@kpi.ua, sidorenko@kpi.ua
URL	http://kpm.kpi.ua
Previous FP Projects Participated	No