Stabilitatea structurala si termodinamica a nanotuburilor pe baza de titanat

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Potentiale aplicatii

Celule solare: electrod pentru celule solare cu pigment sensibil

Baterii pe baza de litiu: electrod negativ pentru baterii

Pile de combustie si baterii: suport pentru electro-catalizatorul oxidarii combustibilului

Stocare de hidrogen si sensori: acumulare reversibila de hidrogen molecular

Catalizator de reactie: catalizator acid–baza pentru reactii de esterificare si hidroliza

Supercondensatori si electrochimie generala: electrozi compoziti pentru procese electrocatalitice

Fotocataliza: latimea benzii interzise in nanotuburi este ~3.87 eV

Splitarea fotochimica a apei si oxidare fotocatalitica: electrod pentru fotoelectroliza apei

Materiale magnetice: nanotuburile de titanat pure au proprietati paramagnetice

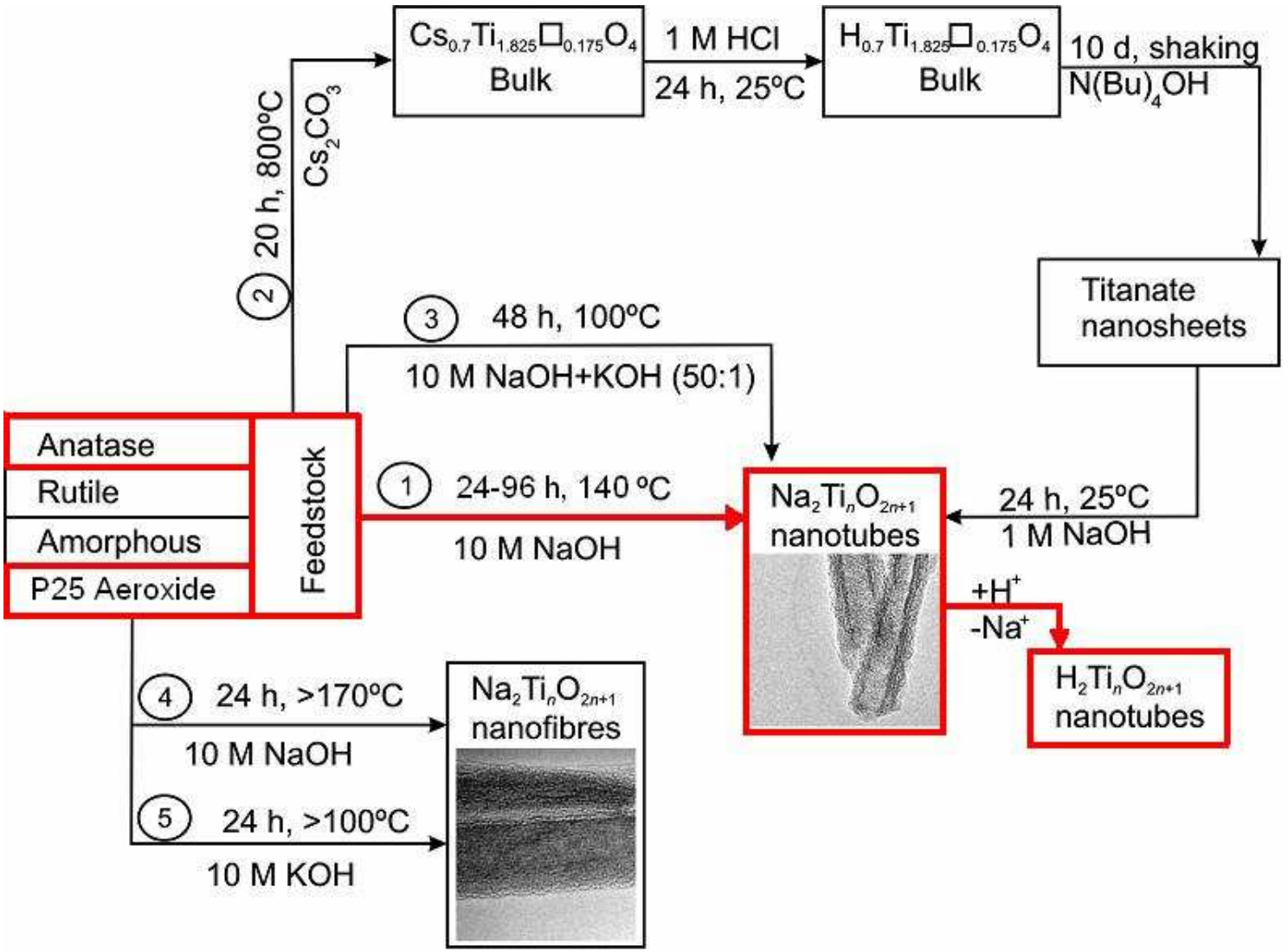
Transportor de medicamente si bioaplicatii: biocompatibilitate

Materiale compozite, acoperiri tribologice

Metode de preparare

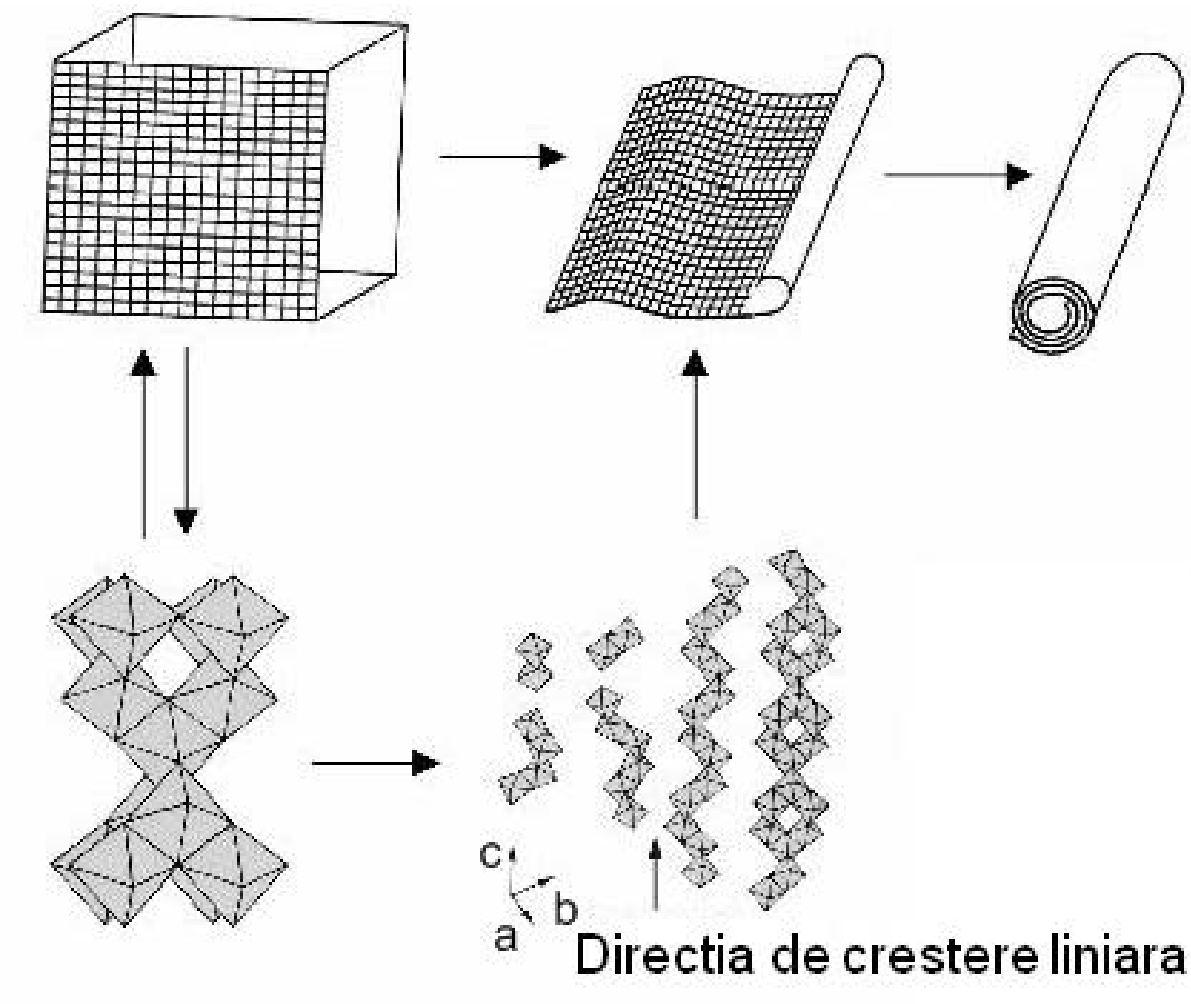
Metoda de fabricatie	Avantaje	Dezavantaje	Catacteristicile nanotuburilor
Metoda asistata de forme predefinite (TEMPLATE)	1) Scara nanotuburilor poate fi controlata prin sablonul utilizat	1) Proces complicat de fabricatie	Siruri ordonate (sub forma de pulbere)
		2) Morfologia tuburilor poate fi distrusa in timpul procesului de fabricatie	
Metoda oxidarii anodice electrochimice	1) Aplicabilitate practica crescuta	1) Productia de masa limitata	Siruri orientate (filme subtiri)
	2) Aliniere ordonata cu raport crescut al aspectului	2) Cinetica rapida de formare este conditionata de utilizarea HF	
	3) Fezabil pentru aplicatii extensive	3) Costuri ridicate a le aparatelor de fabricarie	
Tratament hidrotermal	1) Ruta facila pentru obtinerea morfologiei sub forma de nanotuburi	1) Durata reactiei lunga	Aliniere aleatorie
	2) Poate fi utilizat un numar de modificari pentru a imbunatatii atributele nanotuburilor de titan	2) Concentratii ridicate de NaOH	
	3) Fezabil pentru aplicatii extensive	3) Dificultati in atingerea dimensiunii uniforme	

Metode de preparare



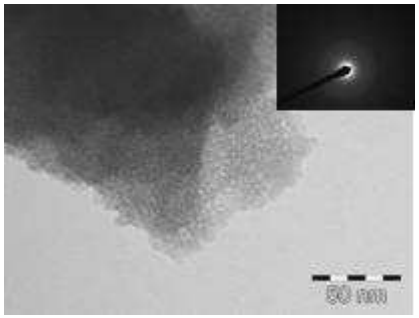
D. V. Bavykin, Frank C. Walsh, Elongated Titanate Nanostructures and Their Applications, *Eur. J. Inorg. Chem. 2009, 977–997*

Mecanisme de formare

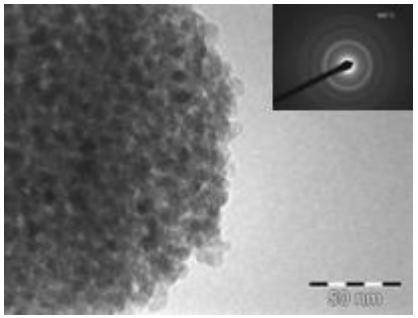


In prima etapa, NaOH destabilizeaza structura cristalina a cristalelor de TiO_2.
Octaedrele libere se reasambleaza prin legarea prin muchii comune si formare de punti hidroxi intre ionii de Ti, conducand la cresterea pe directia [100] a fazei de anatas.
Cresterea laterala are loc pe directia [001], conducand la formarea foliilor cristaline 2D.
Tendinta de saturare a legaturilor libere conduce la rularea foliilor si formarea nanotuburilor.

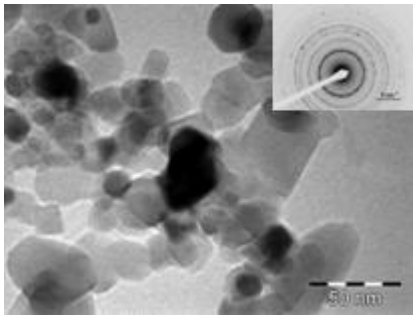
Metode de preparare



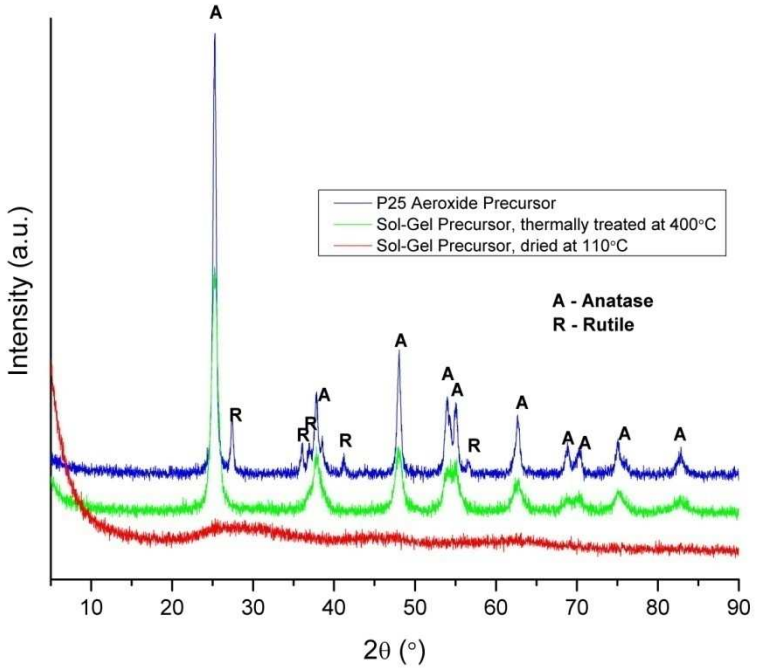
Precursor sol-gel,
uscat la 110°C



Precursor sol-gel,
tratat termic la 400°C

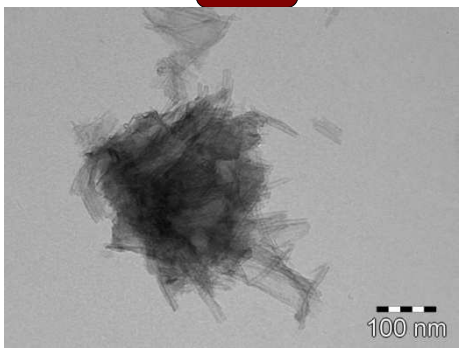


Precursor P25 Aeroxide



Morfologie - structura

D24



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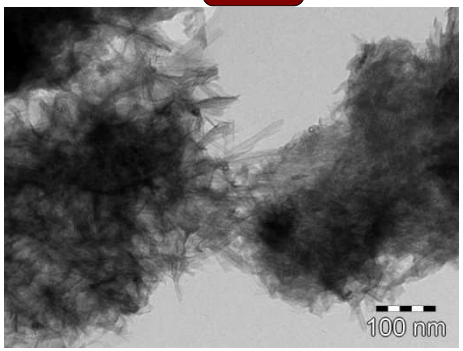

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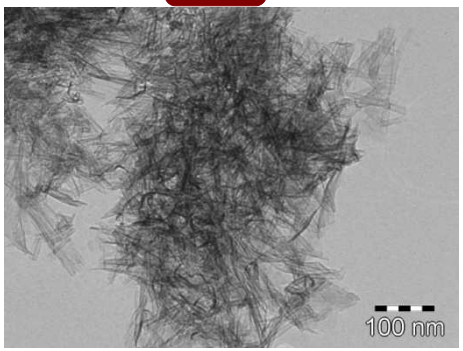

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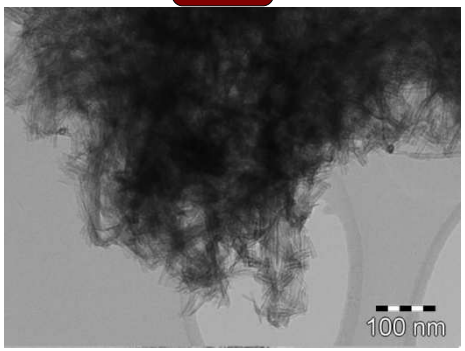

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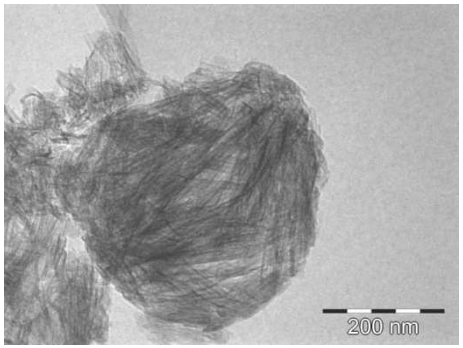

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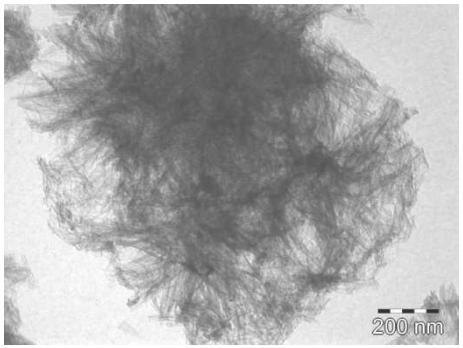

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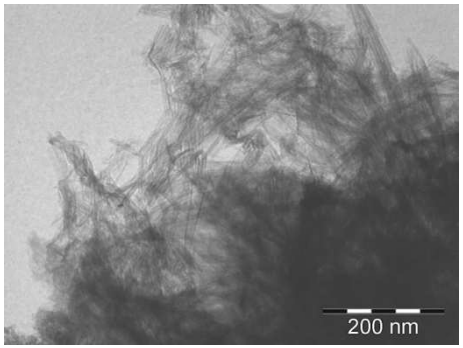

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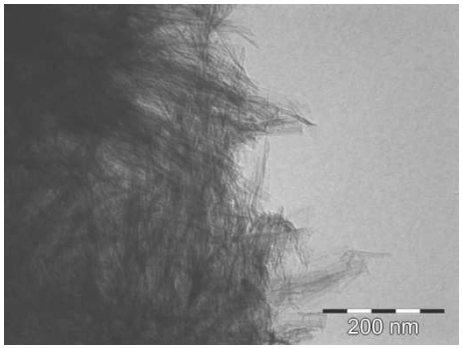
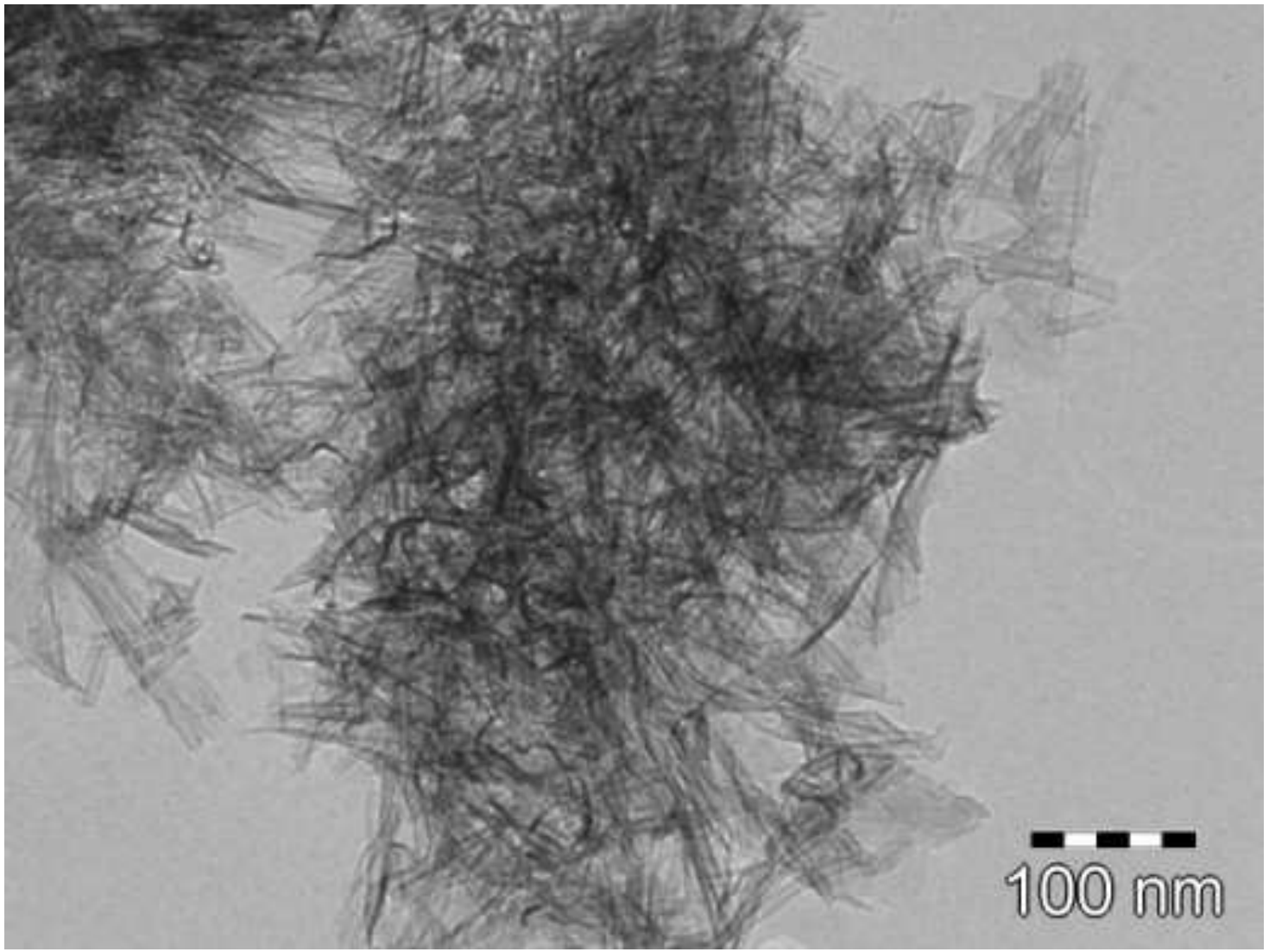


Morfologie - structura

D72



Morfologie - structura

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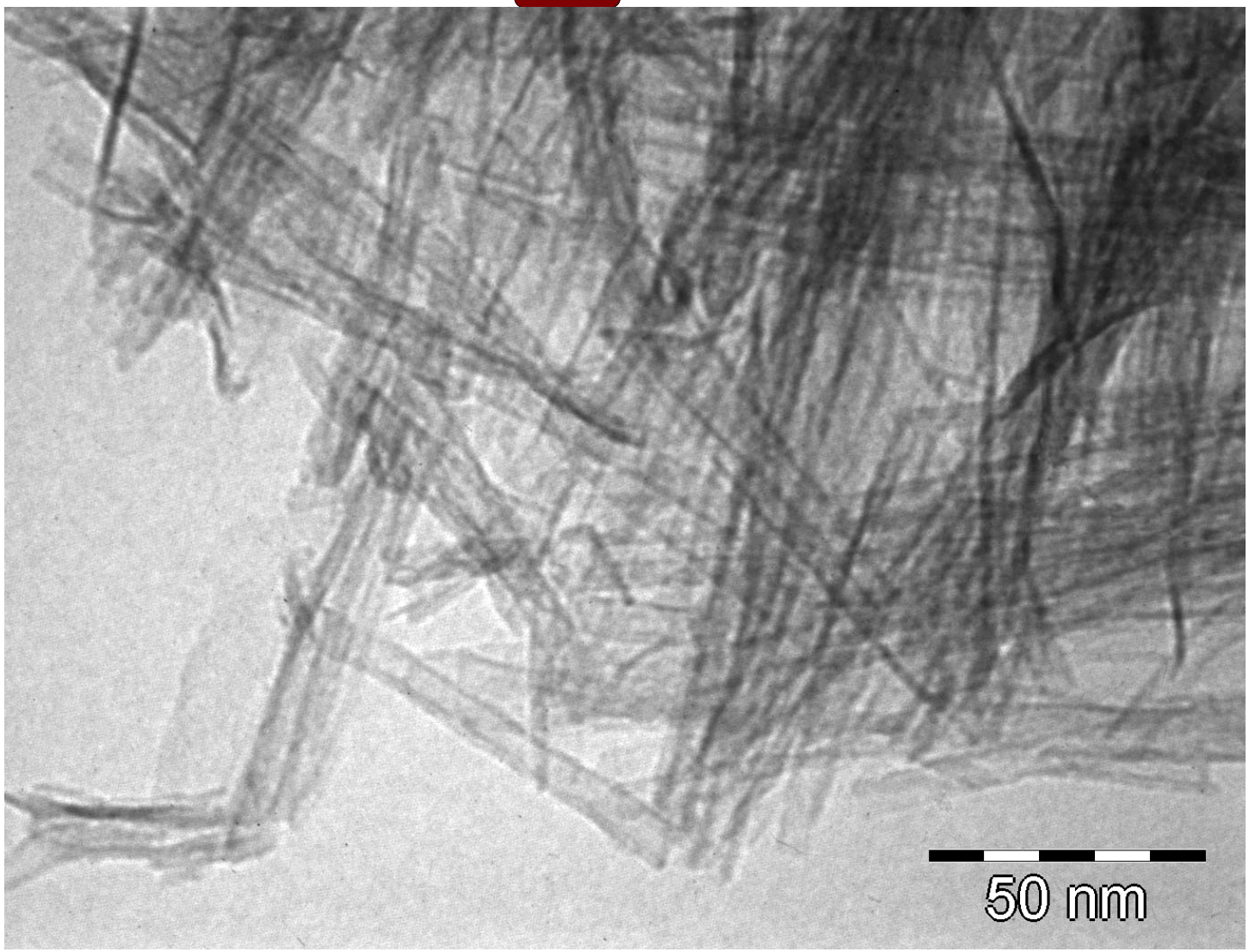
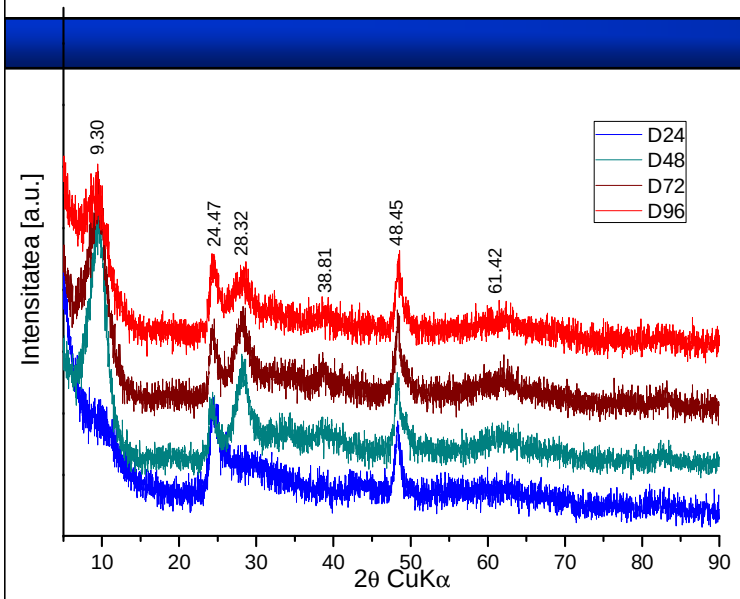
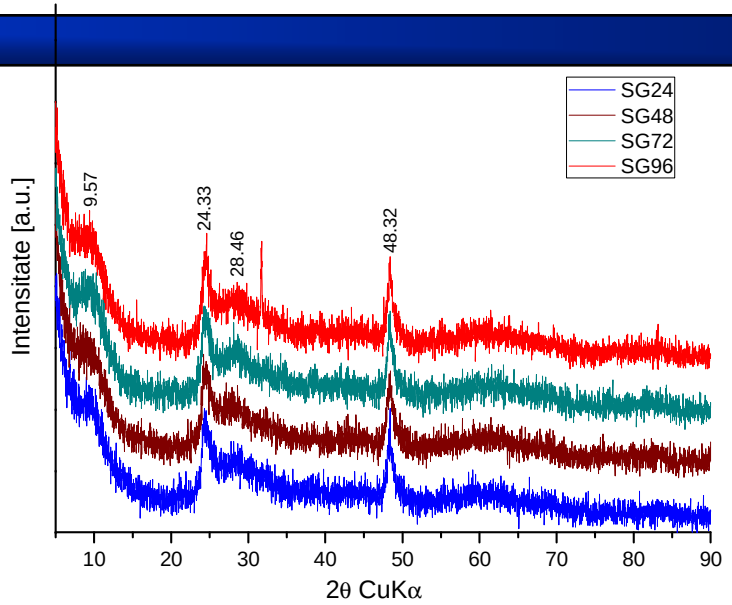


Compozitie - structura



$Na_xH_{2-x}Ti_3O_7 \cdot nH_2O$



$H_2Ti_3O_7 \cdot nH_2O$

Compozitii propuse:

TiO_2 – anatas

$H_2Ti_2O_4(OH)_2$ - ortorombic

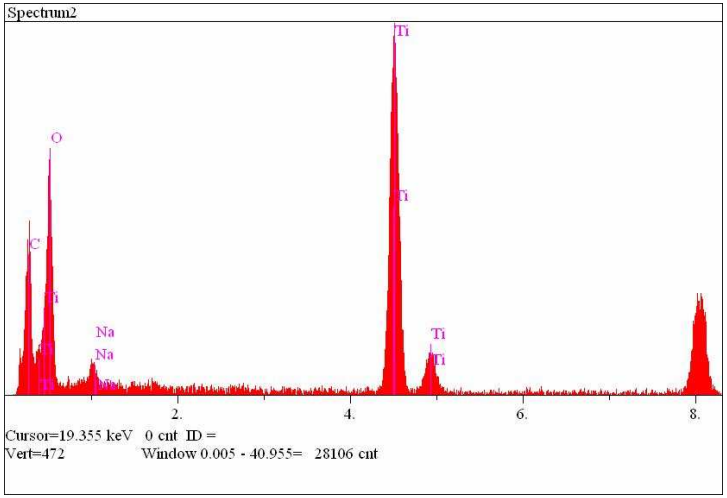
$H_2Ti_3O_7$ - monoclinic

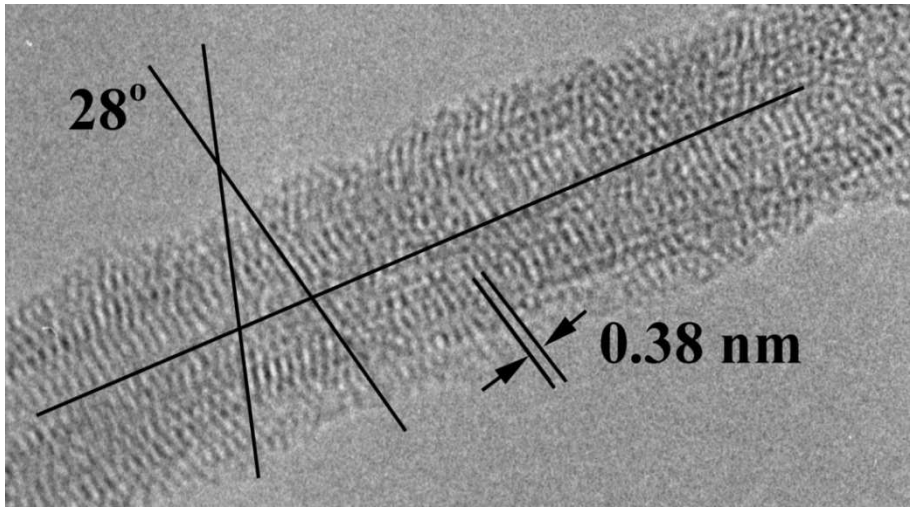
$H_2Ti_3O_7 \cdot nH_2O$ - monoclinic

$Na_xH_{2-x}Ti_3O_7$ - monoclinic

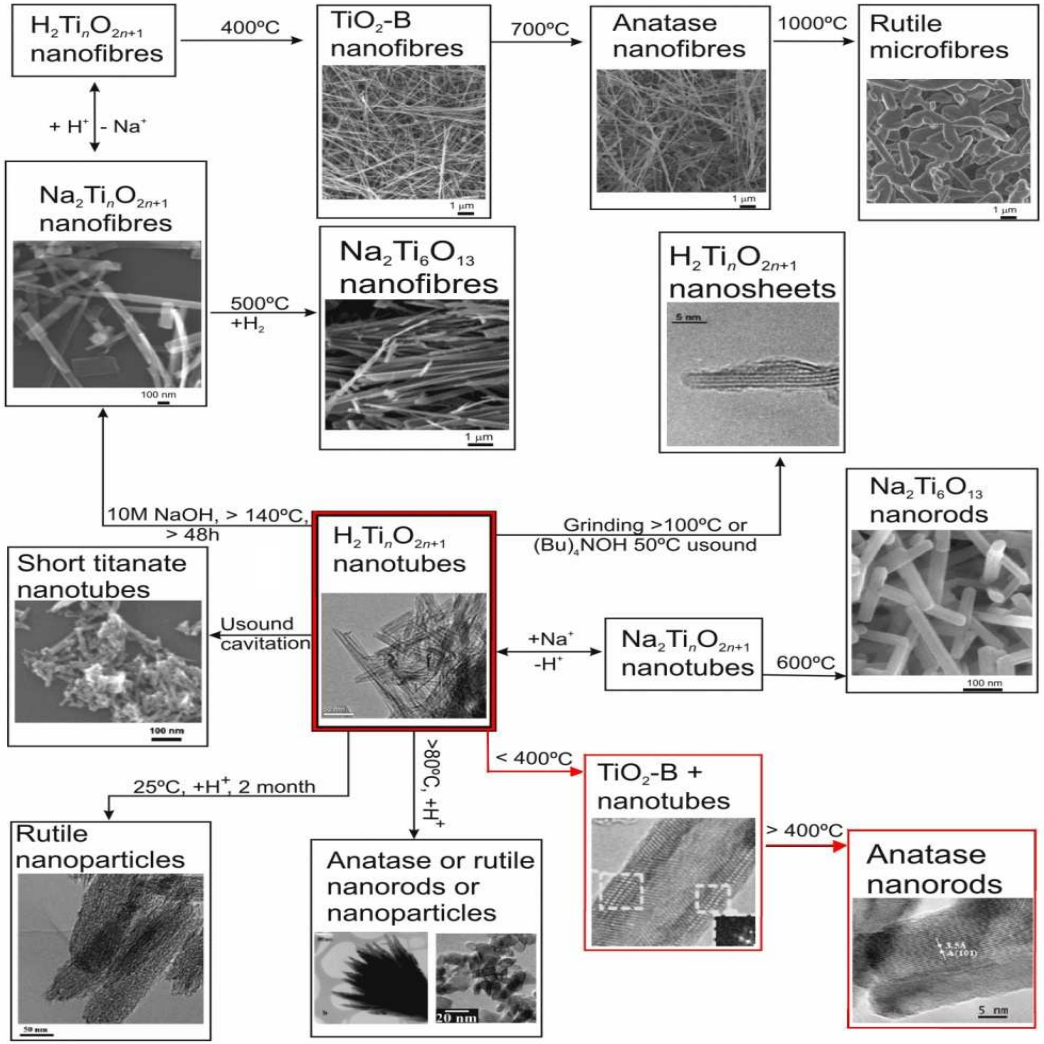
$H_2Ti_4O_9 \cdot H_2O$ - monoclinic

$H_2Ti_{2-x/4}\square_{x/4}O_4$ - ortorombic



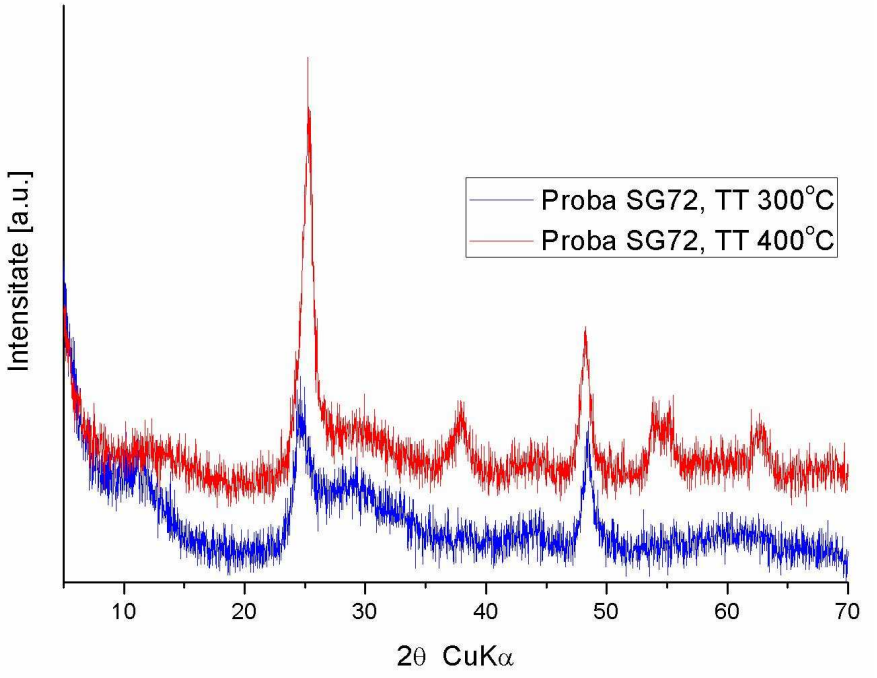


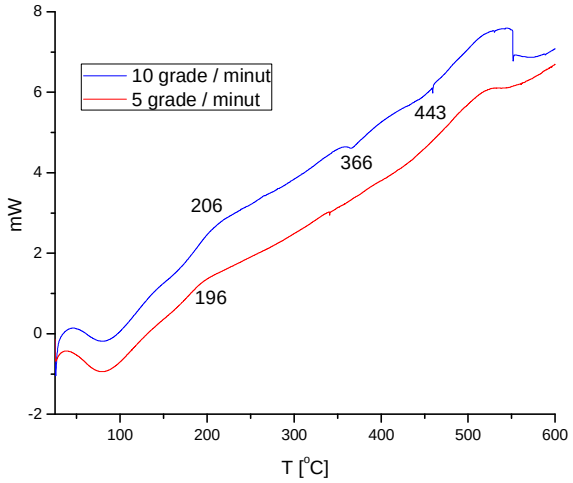
Stabilitatea termica

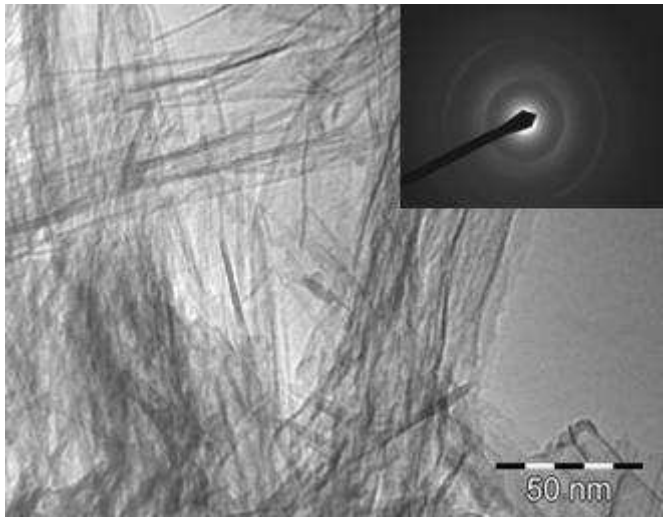


D.V. Bavykin , F.C. Walsh, Titanate and Titania Nanotubes, Synthesis, Properties and Applications, RSC Nanoscience & Nanotechnology No. 12, 2010

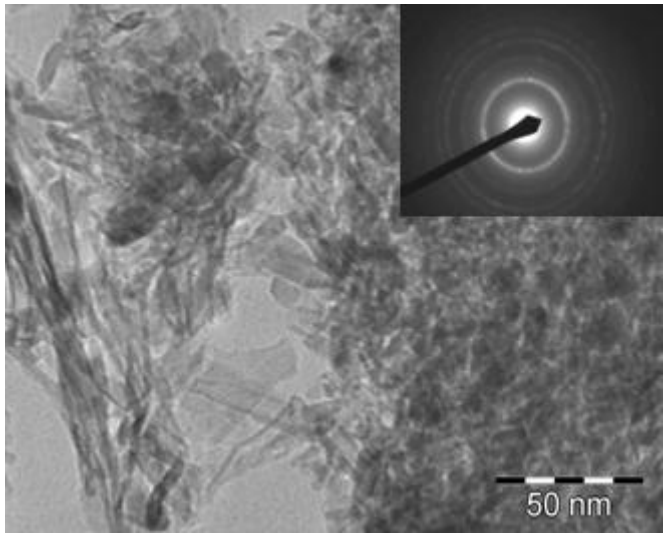
Stabilitatea termica







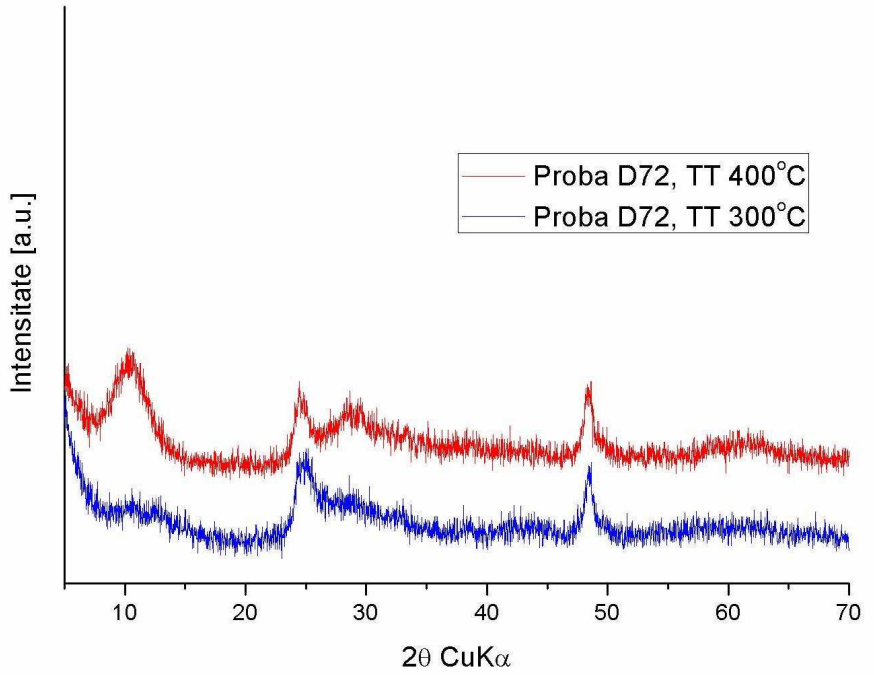
300°C

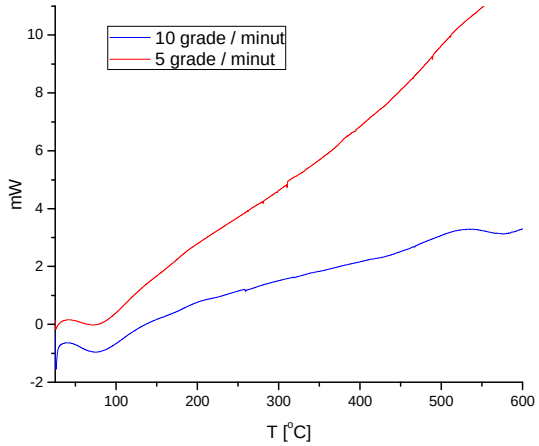


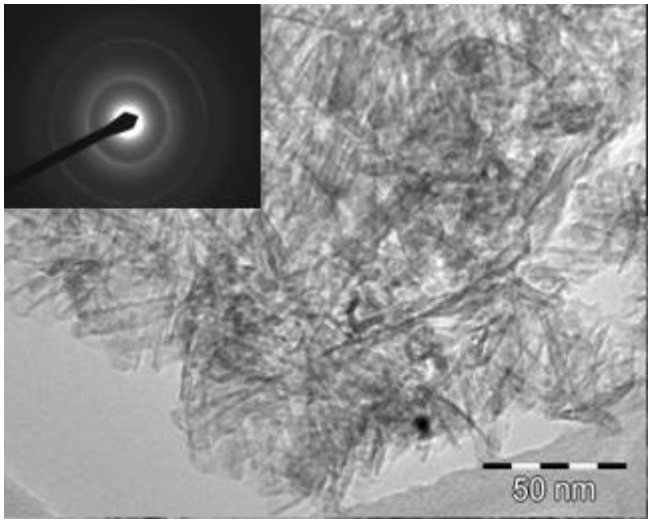
400°C

SG72

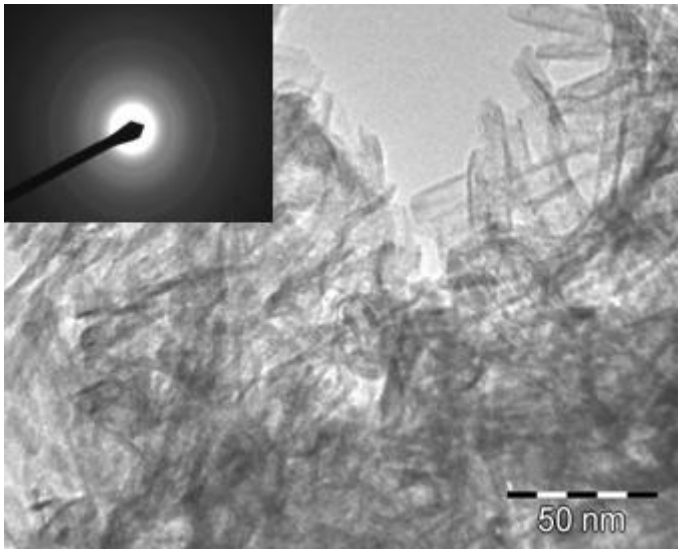
Stabilitatea termica







300°C



400°C

D72

Concluzii

S-a studiat obtinerea nanotuburilor pe baza de titanat pornind de la precursori diferiti, in aceleasi conditii de sinteza

S-a urmarit stabilitatea termica a nanotuburilor obtinute

Nanotuburile au compozitia generala de trititanati, $Na_xH_{2-x}Ti_3O_7 \cdot nH_2O$

Gradul de cristalinitate al precursorului influenteaza morfologia tuburilor

Prezenta sodiului creste stabilitatea termica

Lucrarea a fost realizata in cadrul proiectului NANOTUBOX, program PN2 2007-2010