OPTICAL SYSTEM FOR GENERATION OF VECTOR BEAMS

Alexandru CRĂCIUN, Traian DASCĂLU

1. MOTIVATION

- GENERATION OF VARIOUS CONFIGURATIONS OF VECTOR BEAMS for STED MICROSCOPY and MATERIAL PROCESSING

The optical system consists of the following elements:
- QWP (quarter wave-plate)
- HWP (half wave-plate)
- MC (mode converter)
- SPP (spatial phase-plate)
- PR (polarization rotator)
- Lens

2. FUNCTION OF THE SYSTEM

- The Mode Converter (MC) is a uniaxial crystal with both the entrance and the exit surfaces having a conical shape and with the crystal axis aligned with its symmetry axis.
- The invented system comprises also a part for polarization control that is composed from a QWP and a HWP, a SPP, a PR and a lens.

3. CLAIMS

An optical system according to claim 4, wherein said quarter waveplate is oriented with its fast axis parallel to the polarization direction of the received beam, therefore, preserving the polarization of the received beam, said half waveplate is a converging axicon having a conical surface through which the light exit the system, wherein said birefringent uniaxial crystal, having the anisotropy axis parallel to the symmetry axis of the two axicons and the plane parallel surfaces perpendicular on the same symmetry axis, is located between the two axicons where the beam is divergent.

4. EXPERIMENTAL RESULTS

Preliminary experiments with an optical system based on the principles described in the patent application were done in the ECS Laboratory.

FINANCING: This work was supported by a grant of Ministry of Research and Innovation, CNRS-UFISCID, project PN-III-P4-ID-PCCF-2016-0164, within PNC11 and partially financed by Program NUCLEU-PLAPLAS VI under grant agreement 16N/2019.
The invention relates to the production of doped boro-lead-phosphate glass - nanocarbon composites, which have increased chemical homogeneity, while maintaining the other nanocarbon-induced properties, namely electrical and mechanical properties, and dopants add new optical and magnetic properties, amplified by phosphorus oxide in the vitreous matrix.

The composites according to the invention are obtained by a method for obtaining which consists in the wet preparation of the mixture of raw materials, with the addition of nanocarbon, ultrasonication, drying, heat treatment, pre-melting, melting at low temperatures, homogenization of the melt, casting, annealing and shaping of the homogeneous composite obtained.

Fig. 1. Pre-melting-melting-refining-homogenization program according to the invention, comprising temperatures, time frame, mixing regime, for BPPG3Ce composite.

Fig. 3. Annealing program for BPPG3Ce composite according to the process proposed in the invention, comprising the temperatures and time frame of the annealing process steps.

| Molar percentage | Oxides | B₂O₃ | P₂O₅ | PbO | Li₂O | ZnO | Tb₂O₃, Dy₂O₃, CeO₂, Eu₂O₃, Pr₂O₃, Nd₂O₃, Sm₂O₃, Gd₂O₃, Ho₂O₃, Er₂O₃, Tm₂O₃, Yb₂O₃ | graphene, graphene oxide or nanographite |
|------------------|--------|------|------|-----|------|-----|-------------------------------------------------|
| 0-50%            |        |      |      |     |      |      |                                                 |
| 10-30%           |        |      |      |     |      |      |                                                 |
| 40-70%           |        |      |      |     |      |      |                                                 |
| 5-15%            |        |      |      |     |      |      |                                                 |
| 2-20%            |        |      |      |     |      |      |                                                 |
| 3-15%            |        |      |      |     |      |      |                                                 |
| 3-20%            |        |      |      |     |      |      |                                                 |

Acknowledgements: This work was supported by the Romanian Ministry of Research and Innovation, UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0619/2018, ctr. 42PCCDI and project number PN-III-P1-1.2-PCCDI-2017-0871, ctr. 47PCCDI and Core Program LAPLACE VI, PN 19 15 01 01
Phosphate-tellurite vitreous materials with magnetic and magneto-optical properties, for Faraday rotators and the process for obtaining them

**Patent proposal:** A/00752/19.11.2020

**Inventors/authors:** Elisa Mihail, Iordache Stefan Marian, Sava Bogdan Alexandru, Boroica Lucica, Kuncser Victor, Galca Aurelian Catalin

The invention relates to phosphate-tellurite glasses containing lithium oxide and titanium dioxide and, respectively, zinc oxide and to the process for obtaining them. The preparation process of phosphate-tellurite glasses ensures a high chemical and optical homogeneity of the materials.

Te-1: 35ZnO-10Al2O3-40P2O5-15TeO2
Te-2: 30Li2O-10Al2O3-5TiO2-45P2O5-10TeO2
Te-3: 25Li2O-10Al2O3-5TiO2-45P2O5-15TeO2

Unconventional wet method of reactant processing followed by melting (1100°C-1225°C, mechanical homogenization, refining (melt clarification), shaping by pouring the melt into pure spectral graphite mold, preheated, annealing (removal of residual stresses, 390°C-420°C) and optical processing.

The unconventional method ensures a high chemical and optical homogeneity of the phosphate-tellurite vitreous materials, lower melting and annealing temperatures compared to the conventional ones.

**Faraday magneto-optical effect**

<table>
<thead>
<tr>
<th>Property/Glass</th>
<th>Te-1</th>
<th>Te-2</th>
<th>Te-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low annealing temperature, TIR (°C)</td>
<td>394</td>
<td>394</td>
<td>393</td>
</tr>
<tr>
<td>Glass transition temperature, Tg (°C)</td>
<td>429</td>
<td>427</td>
<td>426</td>
</tr>
<tr>
<td>High annealing temperature, TSR (°C)</td>
<td>440</td>
<td>436</td>
<td>436</td>
</tr>
<tr>
<td>Softening temperature, TD (°C)</td>
<td>453</td>
<td>446</td>
<td>450</td>
</tr>
<tr>
<td>Thermal expansion coefficient, α(°)/K</td>
<td>7.68</td>
<td>11.95</td>
<td>11.19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Glass/ Property</th>
<th>Diamagnetic susceptibility, χ (cm³/g), at 300 K</th>
<th>Faraday rotation angle, θF (°), at 633 nm</th>
<th>Verdet constant, V (min/Oe/cm), at 633 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Te-1</td>
<td>-64(2)·10⁻⁸</td>
<td>0.134°</td>
<td>0.019</td>
</tr>
<tr>
<td>Te-2</td>
<td>-180·10⁻⁸</td>
<td>0.098°</td>
<td>0.015</td>
</tr>
<tr>
<td>Te-3</td>
<td>-370·10⁻⁸</td>
<td>0.127°</td>
<td>0.019</td>
</tr>
</tbody>
</table>

**Acknowledgements:** This work was supported by the Romanian Ministry of Research and Innovation, UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0619/2018, ctr. 42PCCDI and project number PN-III-P1-1.2-PCCDI-2017-0871, ctr. 47PCCDI and Core Program LAPLACE VI, PN 19 15 01 01
Films based on titanium (TiO$_2$) and phosphorus (P$_2$O$_5$) oxides modified with reduced graphene oxide (rGO) with controllable photocatalytic properties and process to obtain them

Patent application: A/00342/2021
Inventors: Ileana Cristina Vasiliu$^1$, Ana Maria Iordache$^1$, Mihail Elisa$^1$, Iulian Pana$^1$ Bogdan Alexandru Sava$^2$, Lucica Boroica$^2$, Ana Violeta Filip$^2$

$^1$National Institute for Research and Development for Optoelectronics (INOE 2000), Romania
$^2$National Institute for Laser, Plasma and Radiation Physics (INFLPR), Romania

The invention refers to a technology using the sol-gel method to obtain with reduced costs, vitreous films with photocatalytic properties based on TiO$_2$-P$_2$O$_5$ modified with reduced graphene oxide (rGO) to be used as anodes in dye-sensitized solar cell (DSSC). The prepared composite films exhibit the photocatalytic properties of titanium dioxide, the phosphorus characteristics to form vitreous structures, transparent, homogenous, with large active surface and large pore volume and the attributes of graphene oxide that improves the photocatalytic properties of titanium oxide.

Acknowledgements: This work was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI-UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0619, Contract 42 PCCDI, PN-III-P1-1.2-PCCDI-2017-0871, ctr. 47PCCDI and Core Program LAPLACE VI, PN 19 15 01 01 Core Program PN 18N/2019

AFM image of the 1.5%rGOTiO$_2$P$_2$O$_5$ film

SEM image of the 1.5%rGOTiO$_2$P$_2$O$_5$ film

UV-Vis-NIR spectra of TiO$_2$-rGO and TiO$_2$rGOP$_3$O$_5$ thin films on glass substrate at different concentrations of rGO in precursors mixture solutions.
Micro-Gantry is a mobile in-house developed modular X-ray system used primarily as a gantry cone-beam tomograph for biology (small animals, plant roots, seeds etc.) and process tomography applications (manufacturing / near conveyor belt, environmental research, corrosion analysis, filters development, polymerization, seed germination, fruit dehydration, etc.).

It features a sealed microfocus X-ray generator (~30 µm resolution, max. 60 kV, 50 W, Wolfram anode) and a compact high resolution flat panel (1944 x 1536 pixels, 75 µm pixel size) mounted on the opposite sides of a frame, aligned with the bed sample holder. Customized software was developed using LabView for rotation control and data acquisition.

The system is able to accommodate a second experimental setup module, with a second X-Ray generator (max. 60 kV, 50 W, Ag anode) and a Si-PIN X-ray detector for X-Ray Fluorescence experiments.

Gantry tomography is used for samples than cannot be moved and need to lie on a sample bed rather than stand in a rotating sample holder (classical tomography). It is the case of small animals or samples that undergo different processes that can be analyzed in situ. A micrometric rotation stage turns the gantry frame around the sample.

The additional fluorescence component can provide qualitative and quantitative information about the sample composition elements.

Contact person: Cosmin Dobrea

cosmin.dobrea@inflpr.ro +4021-4574051

For more info: http://tomography2.inflpr.ro

Micro-Gantry: a Compact Mobile Gantry X-ray Tomograph

Flat panel detector
Sample
Motorized rotation stage
X-Ray tube