DELIVERABLE REPORT FOR THE TREASORES PROJECT

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SUMMARY:

Deliverable 1.1 ‘Relevant documents regarding processes methods and standards and safety aspects’ concerns the preparation of a report listing relevant documents such as good practice guides as well as standards regarding nanomaterials and methods used in this project.

DETAILS

The references to the relevant documents are listed here together with a summary paragraph.

NANOSAFETY

Note that this list of standards and best practice guidelines for safey with nano-materials is provided solely for the convenience of the partners in the TREASORES consortium. It is up to each partner to ensure that they comply with the appropriate legislation in their country and place of work.

BSI (British Standards) PD 6699-1:2007

*http://www3.imperial.ac.uk/pls/portallive/docs/1/34683697.PDF*Part 1: Good practice guide for specifying manufactured nanomaterials. The document contains a definition of nanomaterials as well as characterization methods, possible impacts and guide-lines for packaging, labelling and transportation. The document incorporates numer-ous references.

BSI (British Standards) PD 6699-2:2007

http://www3.imperial.ac.uk/pls/portallive/docs/1/34683696.PDF

Part 2: Guide to safe handling and disposal of manufactured nanomaterials. This document focuses on manufacturing procedures, danger of exposure, risks as well as disposal of nanomaterials. The document incorporates numerous references.

BAuA / VCI report *“*Guidance for Handling and Use of Nanomaterials at the Work-place”.

https://www.vci.de/Themen/Chemikaliensicherheit/Nanomaterialien/Seiten/Guidance-for-Handling-and-Use-of-Nanomaterials-at-the-Workplace.aspx

This report is the outcome of a joint initiate from the (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin/BAuA and the Verband der Chemischen Industrie/VCI regarding safety in the handling and use of nanomaterials.

Documents on "**Safe handling of nanomaterials at workplaces** - Practical Guidance for the Safe Use of Nanomaterials", Workshop of 27./28.11.2012 in Berlin (*http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/Tagungen/Nano-2012/Nano-2012.html*)

The above link allows the download of the presentations given at this workshop workshop by renowned experts from industry, science and politics.

VCI Verband der Chemischen Industrie) "**Responsible Production and Use of Nanomaterials**", March 2008, *https://www.vci.de/Downloads/Responsible-Production-and-use-of-Nanomaterials.pdf*

This article reports on the safe handling of nanomaterials. In particular the requirements of the REACH regulation, gathering hazard information, handling and use of nanomaterials at the workplace, safety data sheets and environmental aspects are treated.

Compendium of Projects in the **European NanoSafety Cluster**, 2011 Edition, *http://www.nanoimpactnet.eu/uploads/file/NanoSafetyCluster/Compendium_2011_web.pdf*

This document provides an overview and summary of all EU-FP projects dealing with the safety of nanomaterials up to 2011. Important references are included in the document.

ISO/TS 27687:2008 Nanotechnologies *-- Terminology and definitions for nano-objects -- Nanoparticle, nanofibre and nanoplate*

This standard lists unambiguous terms and definitions related to particles in the field of nanotechnologies. It is intended to facilitate communications between organizations and individuals in industry and those who interact with them

METHODS

B1) WATER VAPOUR TRANSMISSION RATE (WVTR) THROUGH BARRIER LAYERS

WVTR is an important property of packaging materials and can be directly related to shelf life and packaged product stability. In flexible organic electronic devices, barrier layers can be a significant part of the cost of the complete device. Therefore tests that can rank and compare different barrier layer in terms of performance under specific test conditions can help manufacturers choose the more cost-effective barrier material for their products. The water vapor transmission is not a linear function of film thickness, temperature or relative humidity.

Current test standards include:

ASTM D1653 - 03(2008) Standard Test Methods for Water Vapor Transmission of Organic Coating Films

Describes two test methods to determine the water vapour transmission rate through films of paint, varnish, lacquer, and other organic coatings. The films may be free films or they may be applied to porous substrates.

Test Method A—The Dry Cup Method is the preferred test method for obtaining values that relate to conventional dwellings where high relative humidities are not anticipated.

Test Method B—The Wet Cup Method is the preferred test method for obtaining values that relate to applications where high relative humidities are anticipated in the vicinity of the barrier material. In general, the more permeable a coating is to the passage of moisture as is typical of many water-reducible coatings, the greater its affinity for water and the greater the increase in transmission when tested in and exposed to high humidities. Absorption of water may make a coating less dense, thus allowing moisture to diffuse easily and cause a much higher moisture vapor transmission rate, (WVTR) than would occur in drier environments.

ASTM E96 / E96M - 10 Standard Test Methods for Water Vapor Transmission of Materials

These test methods cover the determination of water vapor transmission (WVT) of materials through which the passage of water vapor may be of importance, such as paper, plastic films, other sheet materials, fiberboards, gypsum and plaster products, wood products, and plastics. The test methods are limited to specimens not over 1¼ in. (32 mm) in thickness except as provided in Section 9. Two basic methods, the Desiccant Method and the Water Method, are provided for the measurement of per-

meance, and two variations include service conditions with one side wetted and service conditions with low humidity on one side and high humidity on the other. Agreement should not be expected between results obtained by different methods. The method should be selected that more nearly approaches the conditions of use.

ISO 2528 Sheet materials -- Determination of water vapour transmission rate -- Gravimetric (dish) method

Specifies a method for the determination of the water vapour transmission rate of sheet materials. Not applicable to film materials that are damaged by hot wax or that shrink under the test conditions

ASTM E398 - 03(2009)e1 Standard Test Method for Water Vapor Transmission Rate of Sheet Materials Using Dynamic Relative Humidity Measurement

This test method covers dynamic evaluation of the rate of transfer of water vapor through a flexible barrier material and allows conversion to the generally recognized units of water vapor transmission (WVT) as obtained by various other test methods including the gravimetric method described in Test Methods E 96/E 96M. This test method is limited to flexible barrier sheet materials composed of either completely hydrophobic materials, or combinations of hydrophobic and hydrophilic materials having at least one surface that is hydrophobic.

The minimum test value obtained by this test method is limited by the leakage of water vapor past the clamping seals of the test instrument. A reasonable value may be approximately 0.01 g/24 h·m^2 for any WVTR method including the desiccant procedure of Test Methods E 96/E 96M at 37.8°C, and 90 % relative humidity. This limit can be checked for each instrument with an impervious specimen such as aluminum foil. Calibration procedures can compensate for the leakage rate if so stated.

ASTM F1249 - 06(2011) Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

This test method covers a procedure for determining the rate of water vapor transmission through flexible barrier materials. The method is applicable to sheets and films up to 3 mm (0.1 in.) in thickness, consisting of single or multilayer synthetic or natural polymers and foils, including coated materials. It provides for the determination of (1) water vapor transmission rate (WVTR), (2) the permeance of the film to water vapor, and (3) for homogeneous materials, water vapor permeability coefficient.

ISO 15106-2 Plastics -- Film and sheeting -- Determination of water vapour transmission rate -- Part 2: Infrared detection sensor method

ISO 15106-2:2003 specifies an instrumental method for determining the water vapour transmission rate of plastic film, plastic sheeting and multi-layer structures including plastics, using an infrared detection sensor.

B2) PHOTOVOLTAICS

IEC 60904 standard parts 1-10 describe tests for photovoltaic devices. The more relevant parts are cited below.

IEC 60904-1 Photovoltaic devices *- Part 1: Measurement of photovoltaic current-voltage characteristics*

Describes procedures for the measurement of current-voltage characteristics of photovoltaic devices in natural or simulated sunlight. Lays down basic requirements for the measurement, defines procedures for different measuring techniques in use and shows practices for minimising measurement uncertainty.

IEC 60904-3 *"Photovoltaic devices - Part 3: Measurement principles for terrestrial photovoltaic (PV) solar devices with reference spectral irradiance data"*

IEC 60904-3:2008 describes basic measurement principles for determining the electrical output of PV devices. The principles given in this standard are designed to relate the performance rating of PV devices to a common reference terrestrial solar spectral irradiance distribution. Covers testing in both natural and simulated sunlight. The main changes with respect to the previous edition include an extended wavelength range and the use of uniform wavelength intervals.

IEC 60904-7 *ed3.0 Photovoltaic devices - Part 7: Computation of the spectral mismatch correction for measurements of photovoltaic devices*

Describes the procedure for correcting the bias error introduced in the testing of a photovoltaic device, caused by the mismatch between the test spectrum and the reference spectrum and by the mismatch between the spectral responses (SR) of the reference cell and of the test specimen. The procedure applies only to photovoltaic devices linear in SR as defined in IEC 60904-10. This procedure is valid for single junction devices but the principle may be extended to cover multijunction devices. This new edition includes the following changes with respect to the previous one: de-

scription of when it is necessary to use the method and when it may not be needed; addition of new clauses.

IEC 60904-8 *Ed. 3.0 Photovoltaic devices - Part 8: Measurement of spectral response of a photovoltaic (PV) device*

ASTM E1021 *- 12 Standard Test Method for Spectral Responsivity Measurements of Photovoltaic Devices*

This test method is to be used to determine either the absolute or relative spectral responsivity response of a single-junction photovoltaic device. This is necessary for computing the spectral mismatch parameter that is used to correct further photovoltaic characterisation, such as the power conversion efficiency. The spectral responsivity of a photovoltaic device is useful for understanding device performance and material characteristics.

ASTM E927 - 10 *Standard Specification for Solar Simulation for Terrestrial Photovoltaic Testing*

This specification provides the performance requirements and parameters used for classifying both pulsed and steady state solar simulators intended for indoor testing of photovoltaic devices (solar cells or modules), according to their spectral match to a reference spectral irradiance, non-uniformity of spatial irradiance, and temporal instability of irradiance. The classification of a solar simulator is based on the size of the test plane, and does not provide any information about electrical measurement errors that are related to photovoltaic performance measurements obtained with a classified solar simulator.

ASTM E973 - 10 *Standard Test Method for Determination of the Spectral Mismatch Parameter Between a Photovoltaic Device and a Photovoltaic Reference Cell*

This test method covers a procedure for the determination of a spectral mismatch parameter used in performance testing of photovoltaic devices. The spectral mismatch parameter is a measure of the error, introduced in the testing of a photovoltaic device, caused by mismatch between the spectral responses of the photovoltaic device and the photovoltaic reference cell, as well as mismatch between the test light source and the reference spectral irradiance distribution to which the photovoltaic reference cell was calibrated.

There are only a few specific standards for OLEDs. The most important are listed below.

IEC 62341 *parts 1 to 6* Describe test methods for Organic light emitting displays

ISO/TR 9241-309 *OLED displays – ergonomics*

ANSI/UL 8752 *OLED panels*

White paper proposing OLED luminous efficacy measurement standardisation from the OLLA FP6 project. Download .pdf from:

http://www.hitech-projects.com/euprojects/olla/news/press_release_4_september_2007/olla update white paper_publicversion2.pdf

"**Measuring the efficiency of organic light-emitting devices**" SR Forrest, DDC Bradley, ME Thompson, *Advanced Materials*, **15**(13) 1043-1048, 2003

For OLED lighting, general lighting standards are being used, such as:

IEC 60598-1 Luminaires

IEC 62031 LED modules for general lighting

IEC 62471 Photobiological safety of lamps and lamp systems

IES-LM-79-08 Electrical and Photometric Measurements of Solid-State Lighting

Efficient Electrical End-Use Equipment (4E) ***International Energy Agency SSL Annex*** *Task 2 report "Solid State Lighting Annex: Interlaboratory Comparison Test Method"*

http://ssl.iea-4e.org/files/otherfiles/0000/0051/SSL_Annex_2013_IC_Test_Method_v.1.0.pdf

This document covers test methods for measurements of electrical, photometric, and colorimetric quantities of LED lamps and LED luminaires that are covered in IEA 4E SSL Annex Interlaboratory Comparisons, which deal only with complete SSL products (LED lamps and LED luminaires) that require AC mains power or a DC voltage power in branch circuit to operate. Non-integrated LED lamps (including tubular LED lamp) and luminaires with a separate LED driver (physically separate from the lamp or the luminaire) are also covered in this document if its driver is sold together or clearly specified by the product specification. LED light engines, LED modules and LED packages are not covered in this document. Testing of the lifetime of the products is not covered.