



# AMUSENS

## D6.1

### Database of gas sensing responses

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<b>Abstract</b>	Database of the sensing responses of the different materials and structures tested individually to various gases and environmental conditions.
<b>Keywords</b>	Database, sensing materials, gas sensor responses



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## Executive Summary

This report describes the content of the Database of sensing materials and their sensing responses, which is produced within AMUSENS project to collect the references to all materials, samples and measurements performed during the project. The first version of the database is the result of WP5 and WP6, for which the materials, devices and measurements, were performed to assess the sensing performances of the various developed materials as a function of their characteristics. This is a document that will be completed all along the project to track all the produced samples and measurements. The database containing the metadata of the measurement with reference to measurement files is published on Zenodo repository under the DOI: 10.5281/zenodo.17881917.

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# Chapter 1 Introduction

The database produced within the AMUSENS project aims at referencing all the materials and samples produced during the project, along with a reference to the characterisation files, as well as the gas sensing responses of the produced devices in various conditions, with a reference to the measurement files. The database structure has been decided within the consortium in WP4, which gave rise to a detailed description of the database structures (D4.2).

The present document describes the data contained in the database at the date of the deliverable, i.e. November 2025, where the properties of the various sensing materials have been characterized individually. The database is however aimed to be regularly updated with all the materials and devices produced in later WPs.

In contrast to the original description of the deliverable in the proposal, the database is not restricted to the gas sensing response only. Due to the strong importance of the material synthesis conditions, the deposition method of the sensing layer and potential post-processing on the sensing properties, it has been decided to extend the database to a full description of material production, as well as their sensing responses.

Due to the large amount of produced data for the gas sensing responses, the database only contains the metadata of these sensing responses, with references to the original data file names, which are unique, following the rules defined in the Data Management Plan (D1.2, updated in D1.7).

The database has been installed on a server at the premises of the partner ICCS and has been made accessible to all partners through secured identification unique to each partner. A Graphical User Interface (GUI) has been programmed by LIST and made accessible to all partners to visualize the database and facilitate its completion. The first version of the database contained in deliverable D6.1 is publicly available on Zenodo repository under the DOI: [10.5281/zenodo.17881917](https://doi.org/10.5281/zenodo.17881917).

## Chapter 2 Structure of the database

The database structure has been fully described in the deliverable D4.2: Database structure for gas sensing materials specifications and metrological qualification data. The chosen format is JSON, and the database is nested with each collection related to the previous one through unique identifiers. The global structure of the collections and their links is described in Figure 1.

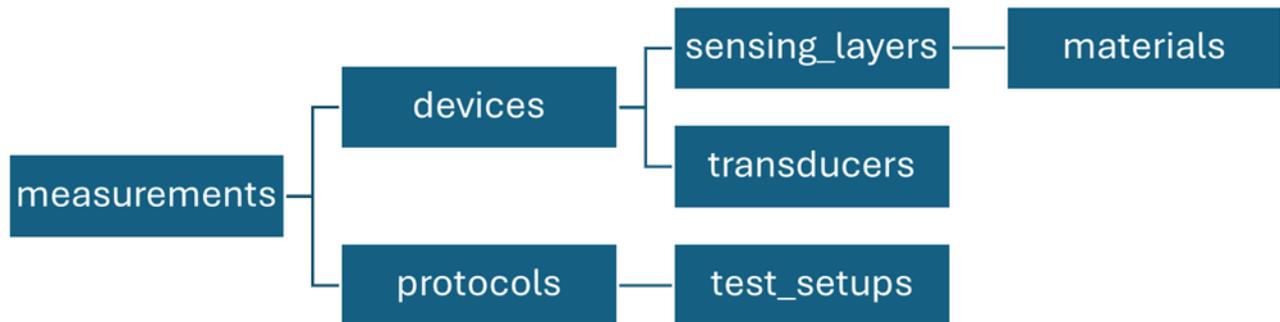


Figure 1: Global structure of the database showing the different collections and their links.

## Chapter 3 Data description

This chapter described the content of the different collections of the database at the time of the submission, i.e. November 2025. The database is aimed to be completed with additional elements all along the project.

### 3.1 Materials

15 materials are referenced for all production methods:

- Colloidal synthesis – metal oxide (MO) nanoparticles: Co<sub>3</sub>O<sub>4</sub>, CuO, In<sub>2</sub>O<sub>3</sub>, NaTiO, SnO<sub>2</sub>, V<sub>2</sub>O<sub>5</sub>, WO<sub>3</sub>
- Batch atomic layer deposition (ALD): Al<sub>2</sub>O<sub>3</sub>, Pt, SnO<sub>x</sub>
- Direct atomic layer processing (DALP<sup>®</sup>): Al<sub>2</sub>O<sub>3</sub>, Pt, SnO<sub>2</sub>, WO<sub>3</sub>, ZnO

### 3.2 Sensing layers

102 elements are referenced, corresponding to the different combination between different MO nanostructures and ALD coatings, as well as different formulation, deposition methods and post-processing conditions. This is an extensive list of all sensing layers developed, although not all are included in the tested devices.

### 3.3 Transducers

3 elements are referenced, corresponding the ones produced by UNIBS and LIST for individual material testing.

### 3.4 Devices

107 elements are referenced, corresponding to all devices that have been prepared, have been tested under gas exposure and are included in the measurement files.

### 3.5 Test setups

7 elements are referenced, corresponding to the different set-ups used in different locations, and with different sample configurations.

### 3.6 Protocols

12 elements are referenced, corresponding to the initial “material screening protocol” defined in WP4 for selecting the sensing materials for their selectivity to different gases, varying depending on the investigated conditions.

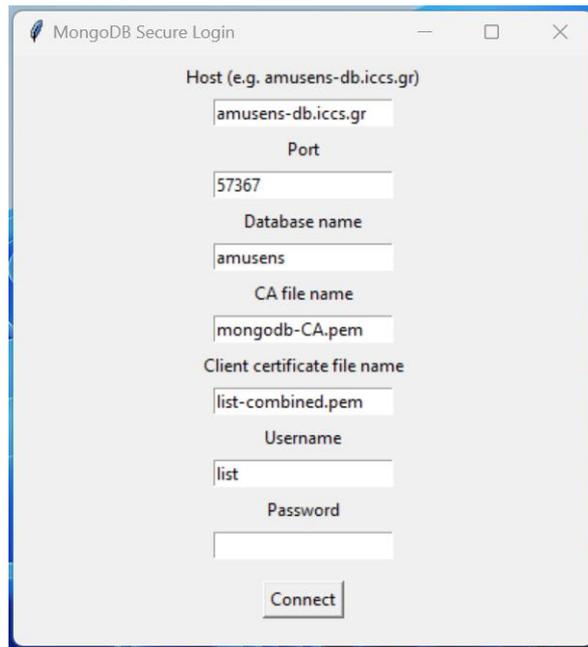
### 3.7 Measurements

107 elements are referenced for the raw data. Each element combines different tested devices and sensing layers, as well as different gases, i.e. several devices and measurements conditions are usually contained in a single file.

## Chapter 4 Description of the produced GUI

A Graphical User Interface (GUI) has been programmed in Python to access, visualize, add, edit and delete elements in the various collections of the database. The GUI has been made available to all partners.

At the start of the GUI, an opening window (Figure 2) displays the connection options to the database hosted by ICCS.



MongoDB Secure Login

Host (e.g. amusens-db.iccs.gr)  
amusens-db.iccs.gr

Port  
57367

Database name  
amusens

CA file name  
mongodb-CA.pem

Client certificate file name  
list-combined.pem

Username  
list

Password

Connect

Figure 2: Opening window of the GUI displaying the connection options.

After connecting to the database, the main window opens (Figure 3) and displays:

- Left column: all collections included in the database, along with a button to include a new element from a template, included in a separate hidden collection of the database.
- Middle column: All elements in the selected collection, along with a text line to filter specific text, and buttons to edit, Delete or Duplicate the selected element.
- Right column: Display of the text corresponding to the selected element.

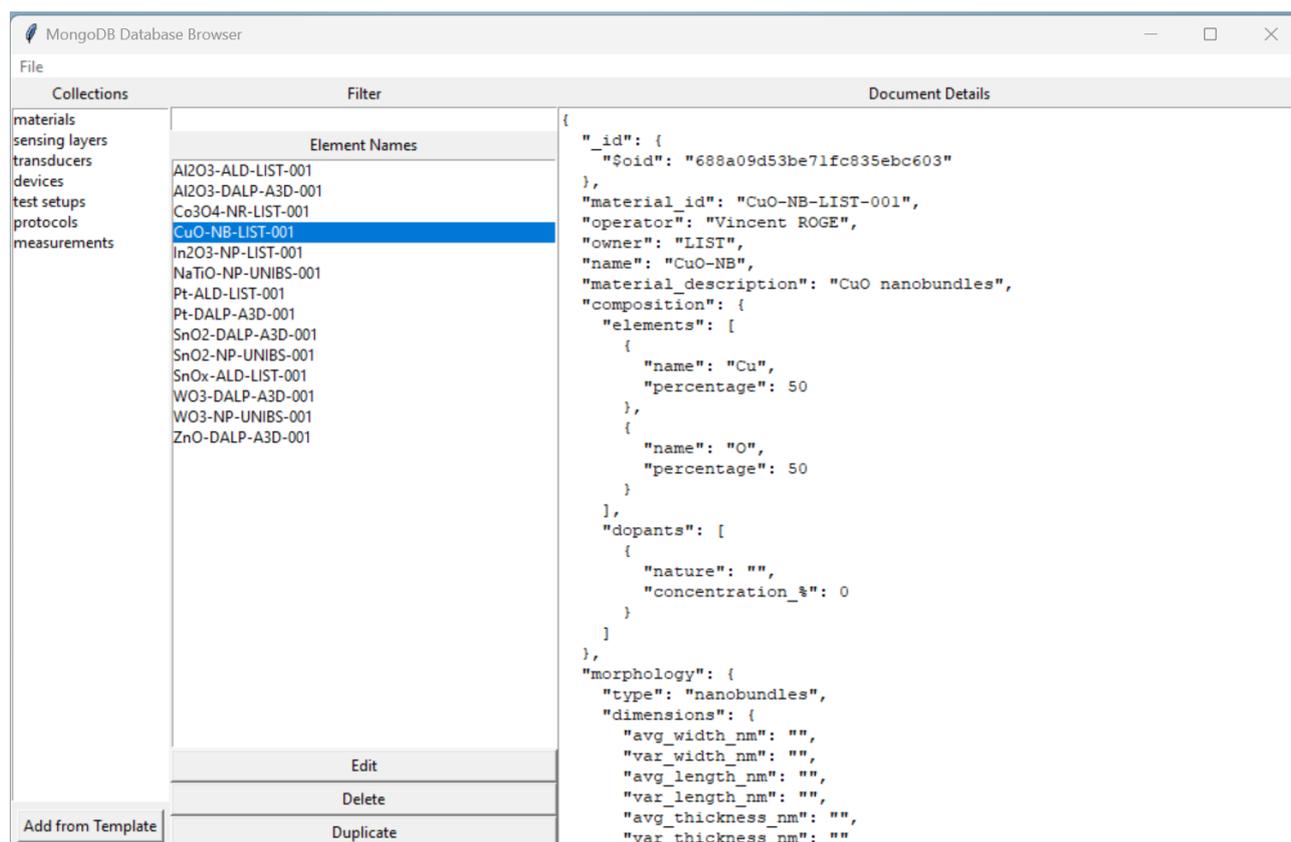


Figure 3: Main window of the GUI, displaying the collections, the elements in the selected collection and the detailed content of the specific element.

Each element can be displayed and edited through separate GUI by using the Edit button, which opens a separate window with all available fields to be displayed (Figure 5).

Specific fields are list that can be modified using buttons on the right of the list, which opens a new editing window (Figure 5). For fields linked to another collection, the field appears in grey and the user can choose the specific id through the “Select” button. This avoids mistakes in linking the various collections through unique identifiers.

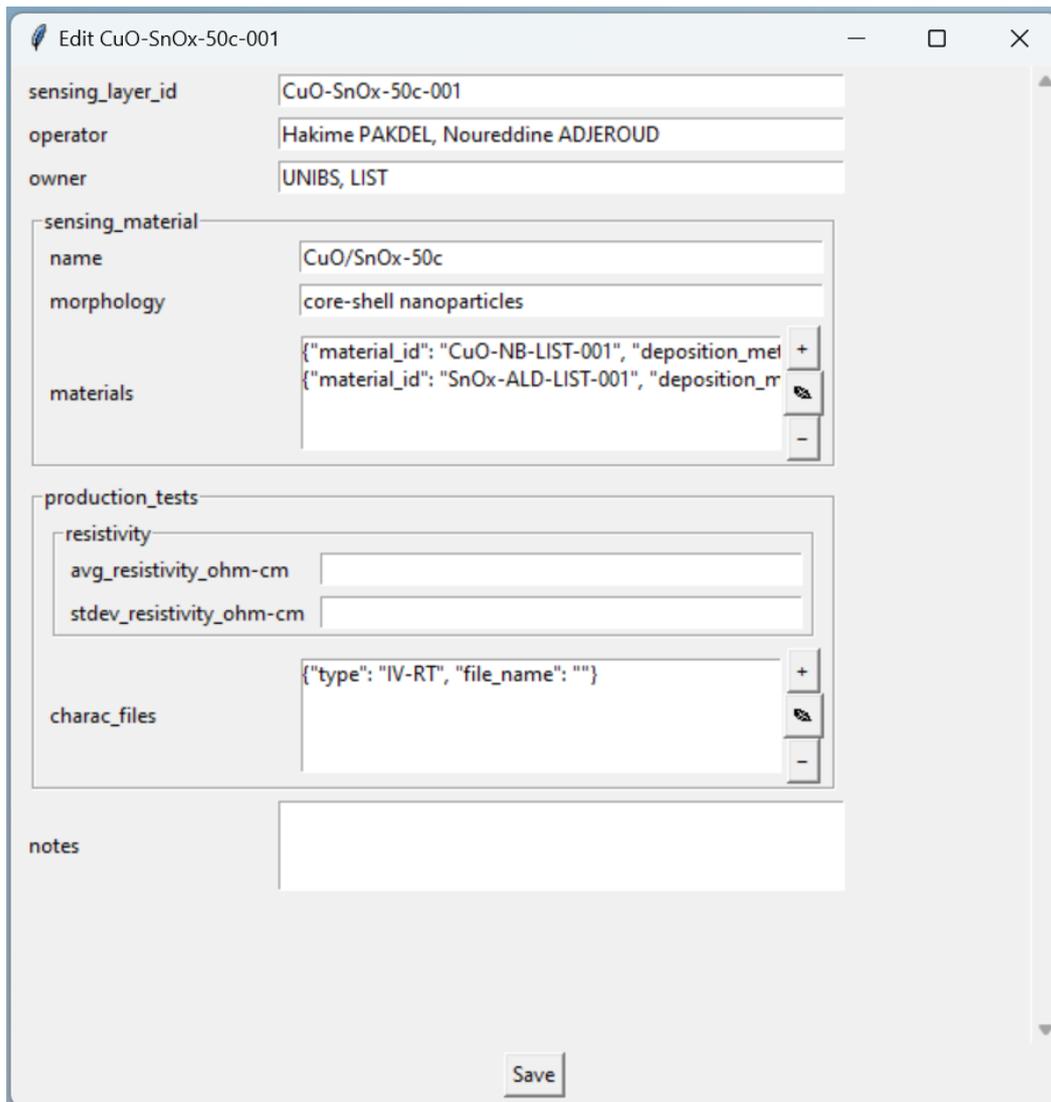


Figure 5: Editing window for a specific element, which follows the structure of the JSON file.

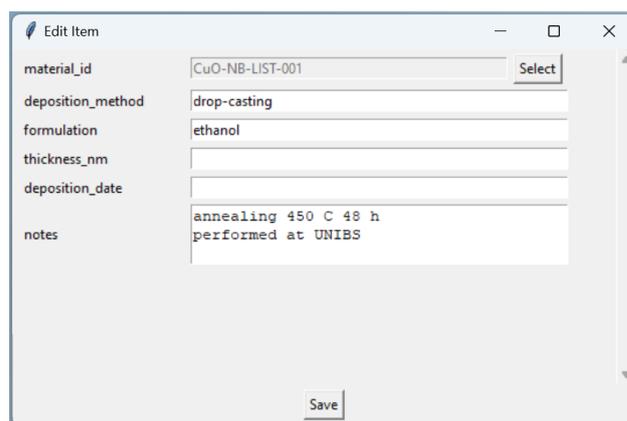


Figure 5: Window used for editing the fields of an element in a list. The first field in this example is a linked field to another collection.

## Chapter 5 Gas sensor response measurements

Although a full list of measurements cannot be provided as an open access dataset at this early stage of the project, we provide in the **Annex** of this deliverable a set of response curves measured both at UNIBS and LIST for the various kind of materials, metal oxide (MO) nanostructures and coated MO nanostructures. Due to the sensitive aspect of these measurements, which will be part of future publications and could be included in the exploitation strategy of the project, the **Annex** constitutes a sensitive attachment of the current public deliverable.

## Chapter 6 Summary and Conclusion

This report described the database of gas sensing materials and their sensing response which is provided as deliverable D6.1. The goal of this database is to reference all materials and devices produced during the AMUSENS project, along with their gas sensing response in various conditions. It serves as a basis for the analysis made by artificial intelligence algorithm for the selection of the most appropriate materials to include into the multi-pixel sensing platform based on their sensing properties.

The database is aimed to be completed all along the project with additional measurements and potentially different material production methods. In the future, this database is expected to be a reference document for future users of the multi-pixel platform to be able to design a multi-pixel sensor on-demand, targeting specific gases. It is thus aimed to be completed even after the project end for the purpose of design of future multi-pixel sensor devices.

The database is completed by a recording of all raw measurement data saved in a folder shared among the partners during the course of the project. A complete set of these recording is reported in the Annex attached to this deliverable for completion. These data will be further validated during the course of the project and included in D8.1. A subset of these data will be further published as open source data to be used to train future algorithms.

## Chapter 7 List of Abbreviations

Abbreviation	Translation
ALD	Atomic layer deposition
DALP®	Direct Atomic Layer Processing
GUI	Graphical User Interface
MO	Metal oxide