CA Growth Simulator

Quick project guide

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Contents

1. Introduction

The software allows for simulation of various cellular automata scenarios that involve inclusions and seed growth on a microstructure. It is also capable of saving results and recreating them from .txt and .bmp files.

2. GUI overview

The program allows for adjusting various settings, including: board size, simulation type, number of nuclei to grow, saving complete microstructure to a file adjusting view settings. It is advisable to use a mouse with at least 3 buttons to ensure the most comfortable experience.

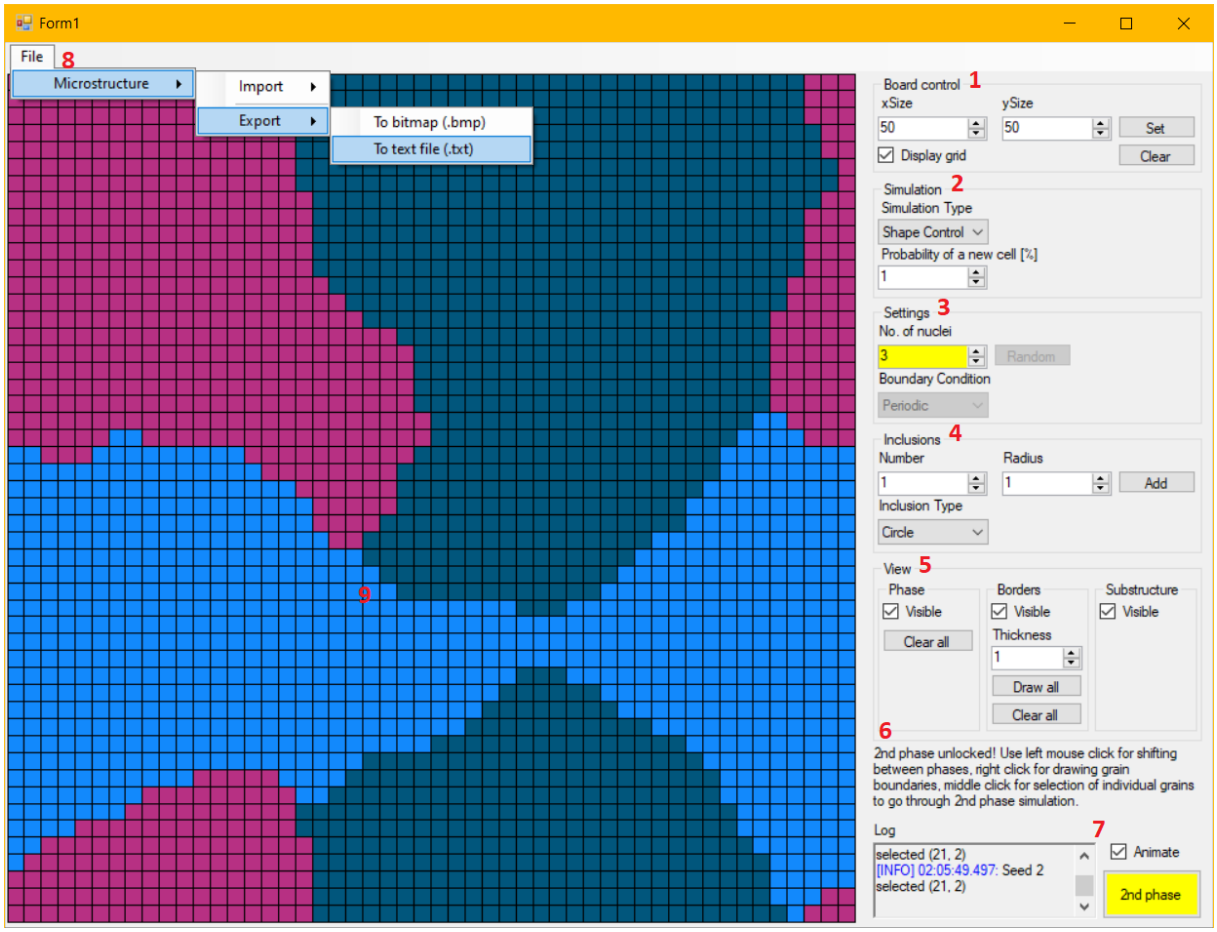

Figure 1 GUI overview

1. Board control panel
    - Allows for adjusting board's size and displaying the grid view. Can also be used to clear the whole space and reset the simulation back to phase 1.
2. Simulation control panel
    - User can switch between ***Simple*** and ***Shape Control*** simulation types. The *Probability* numeric window is only available for the shape control simulation and influences creation of new cells in place of empty ones. Higher values lead to results very similar to ***Simple*** simulation type.
3. Settings
    - Allow for setting vital options needed for simulation. User can pick boundary conditions and the number of seeds to grow (placed on the board randomly)
4. Inclusions control panel
    - User can add inclusions either before or after simulation (only on grains' borders). Available types are ***Circle*** and ***Square*** inclusions. Inclusion cells always have black colour and do not participate in grain growth remaining fixed in one position.
5. View control
    - User can switch between various board views or combine multiple at once. Available views are for: dual phase, grain borders and substructure view. Available only after 1st phase simulation is finished.
6. 2nd phase label
    - Explains additional control user has over the board after 1st phase simulation ends.
7. Log window and animation controls
    - The log window informs about current events and potential warnings/errors during simulation. The checkbox allows for switching between smooth animation of an ongoing process or drawing the whole board after finishing.
8. Microstructure menu
    - Gives the ability to export/import microstructure files from/into the simulator. Both options are capable of retaining dual phase information.
9. Board
    - Represents the current state of simulation, allows for interaction with individual grains after the 1st phase.

3. Quick usage instruction

1. Set the board's size in the **Board control** panel
2. Pick simulation type
    - If **Shape Control** was selected, also set the probability value
3. *Optional:* set number of inclusions and their type and press **Add.** Inclusions will be added, indicated by black-coloured cells on the board.
4. Pick boundary condition type
5. Define how many grains you want to simulate and press the **Random** button
6. Define whether you want an animated simulation and press the **Run** button. Animation checkbox can be changed mid-simulation to speed up the program's work.
7. You've entered the 2nd phase simulation. Read the label that appeared to fully understand the new controls.
8. *Optional:* adjust the view on the board. You can change:
    - **Dual phase** view
    - **Border** view
    - **Substructure** view
9. Set the number of new seeds that will appear in zero-phase grains. Use the numeric textbox next to the **Random** button, it is now highlighted
10. Press the **2nd phase/**run button and wait for the results
11. *Optional:* Save the results using the **Microstructure** menu

4. Examples with images

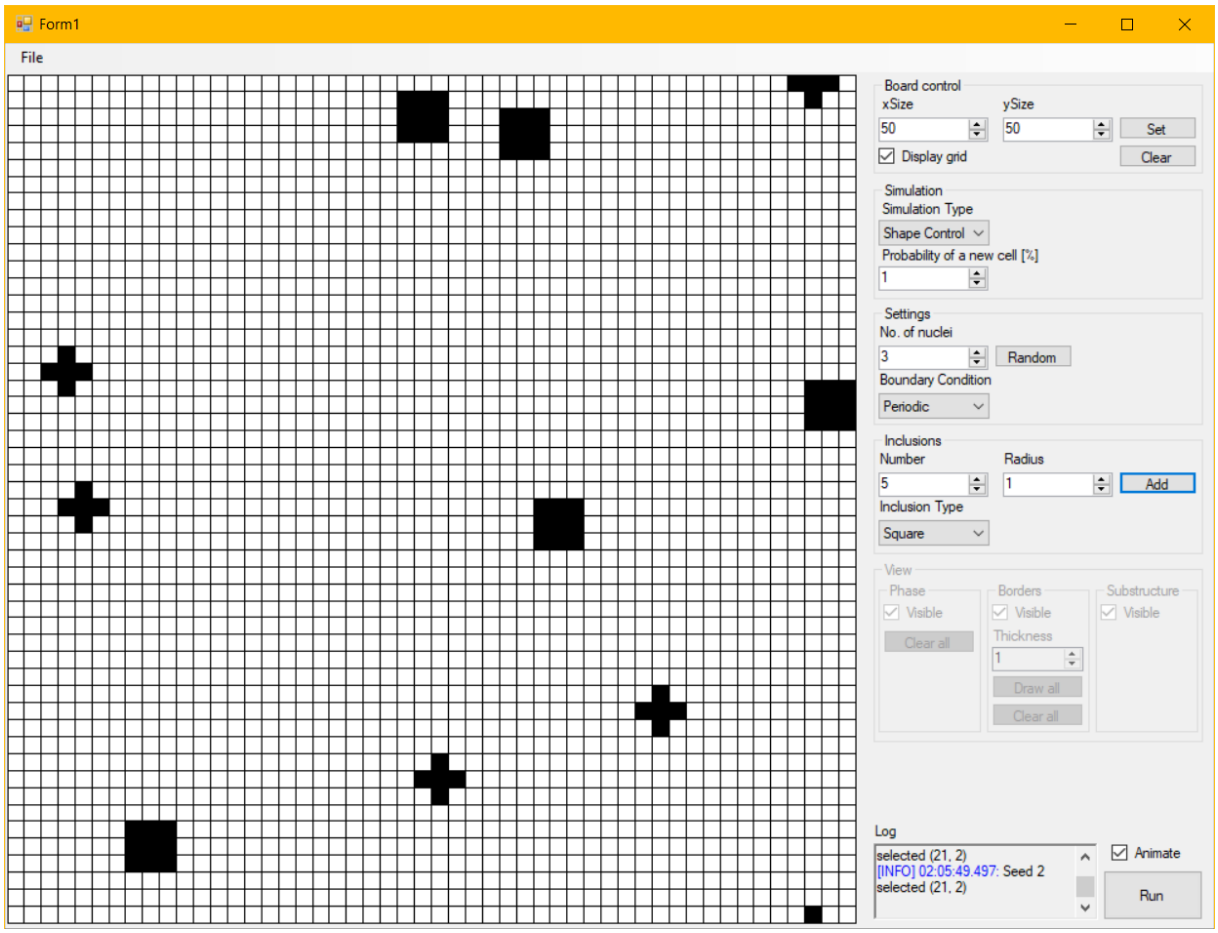

Figure 2 Adding various types of inclusions before simulation

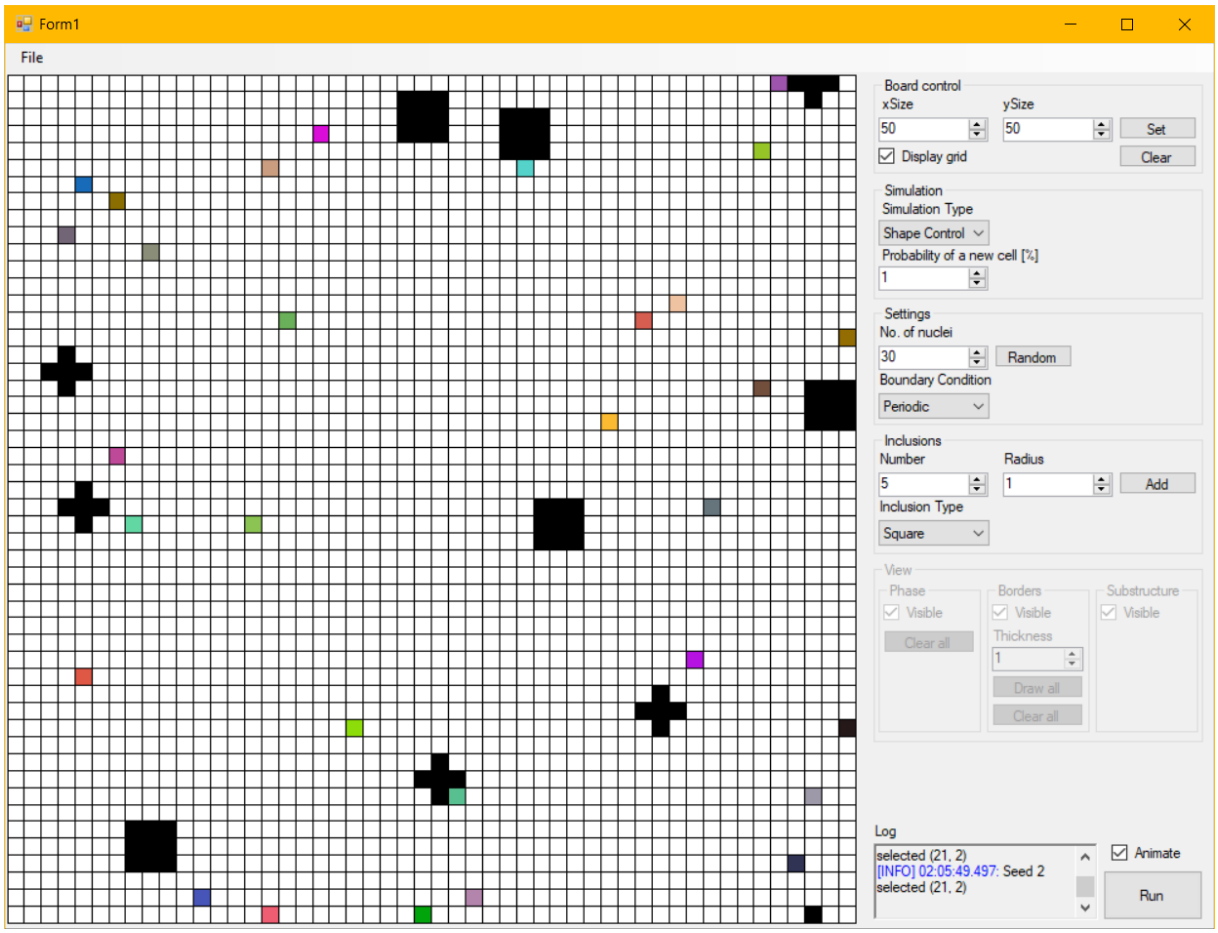

Figure 3 Board state after adding 30 random cells

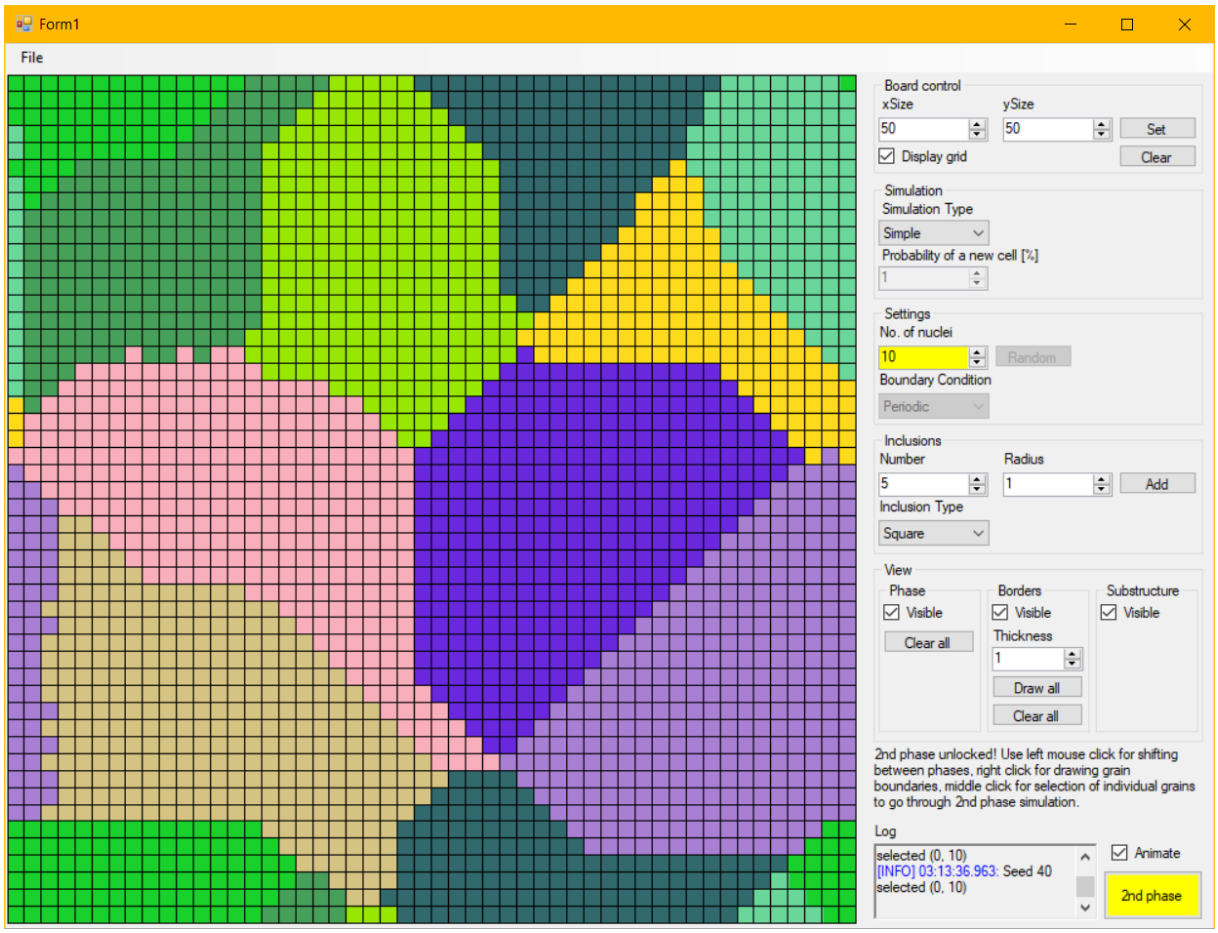

*Figure 4 Example of the **Simple** type of simulation*

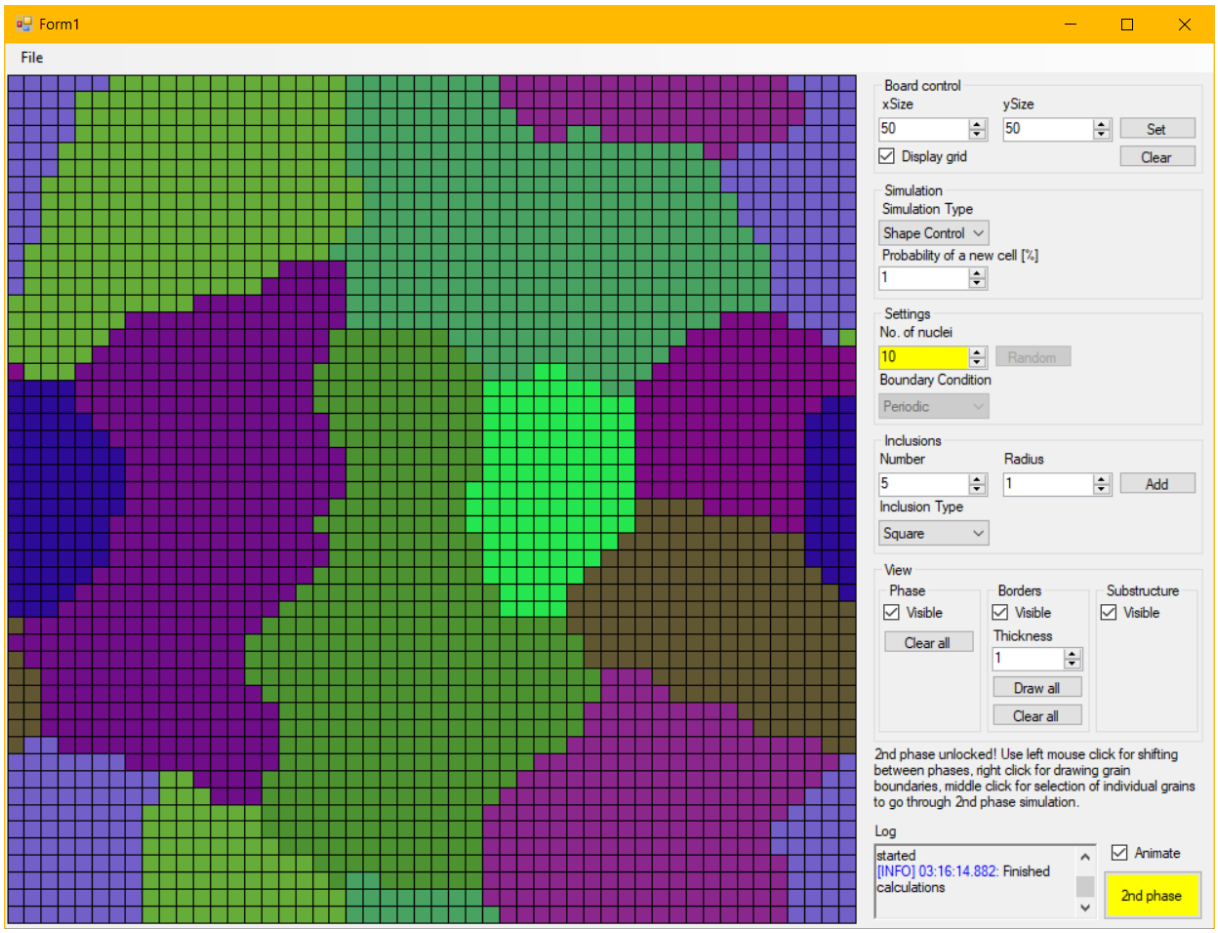

*Figure 5 Example of the **Shape Control** type simulation with **Probability 1%***

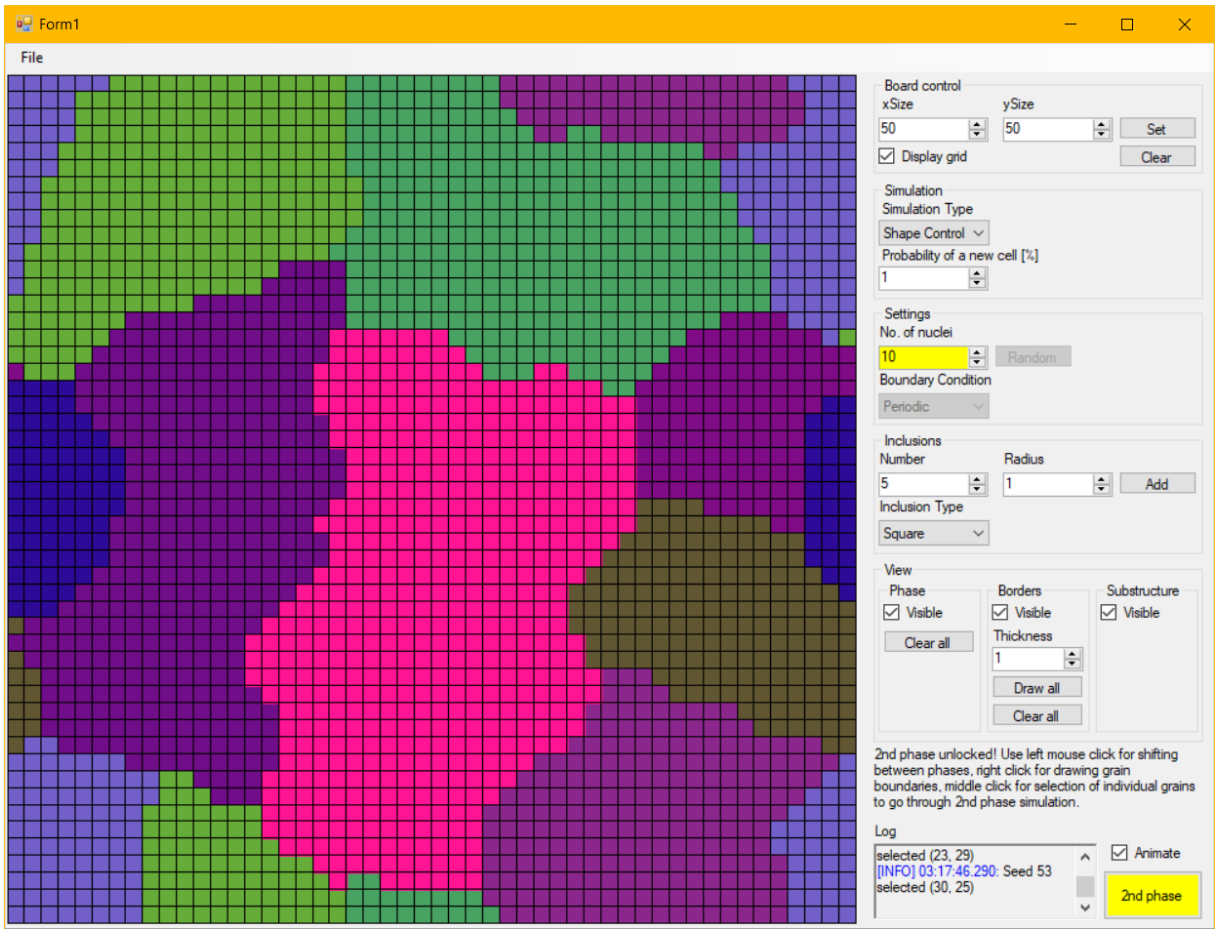

Figure 6 Moving grains to phase 1 (marked deep pink)

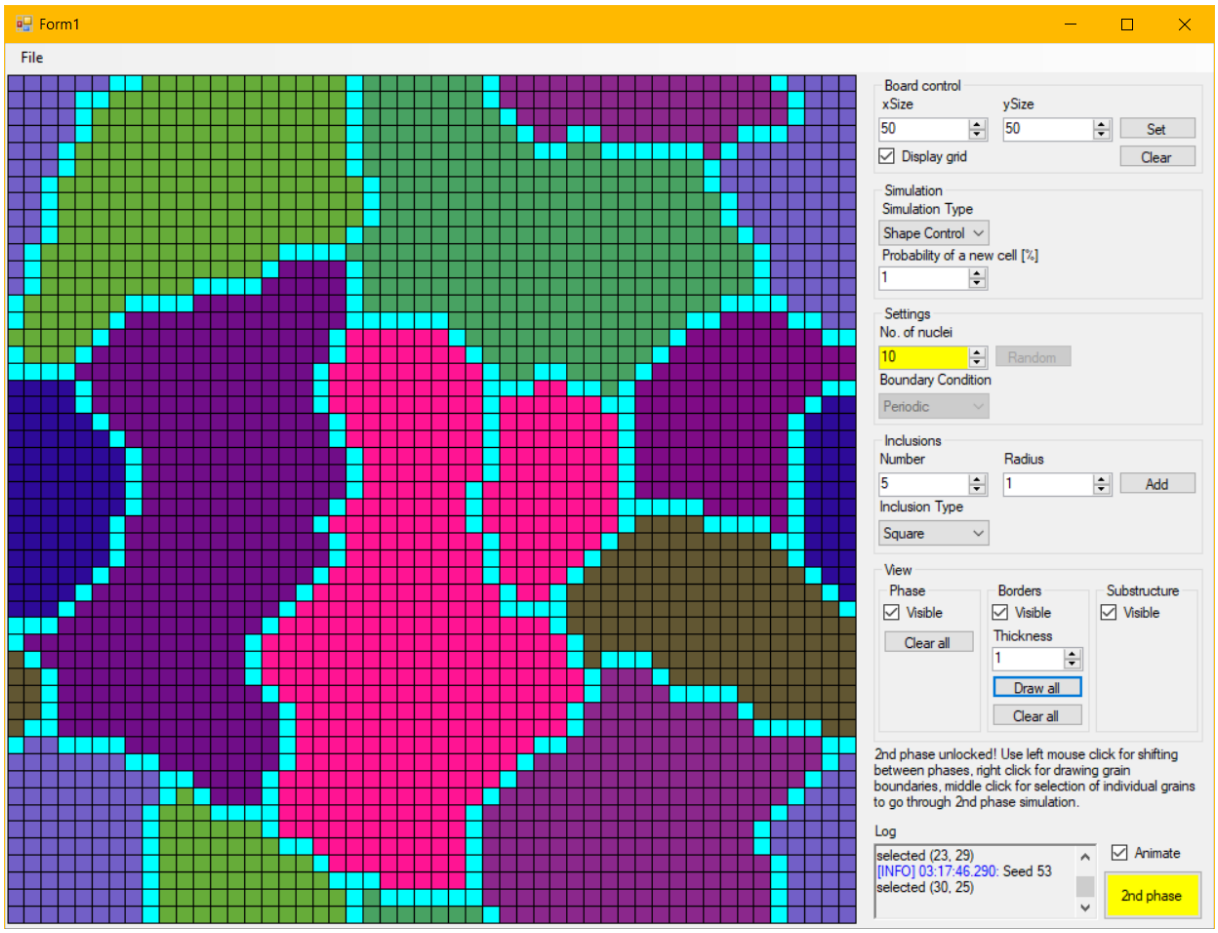

Figure 7 Drawing borders between grains

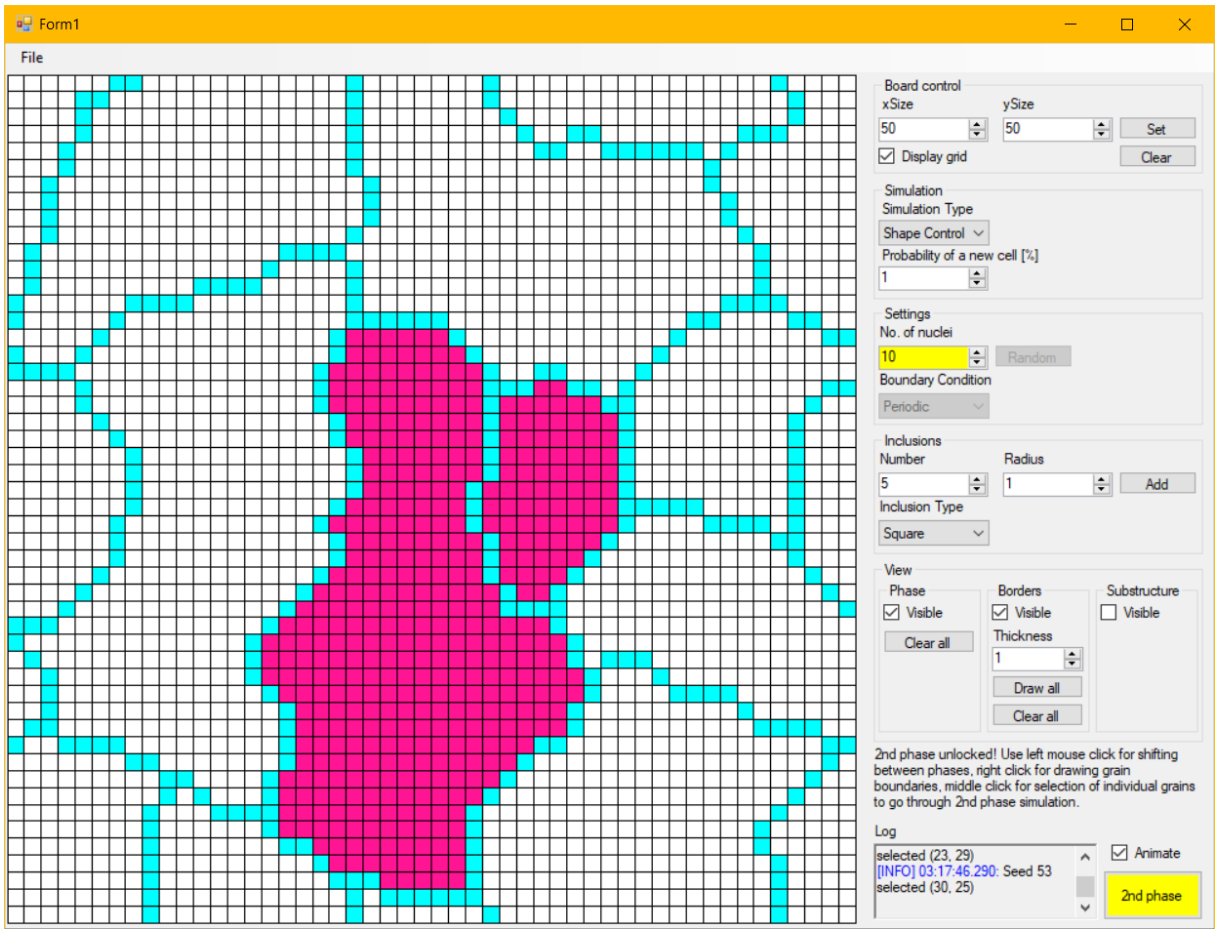

Figure 8 View with just phase 1 grains and borders visible

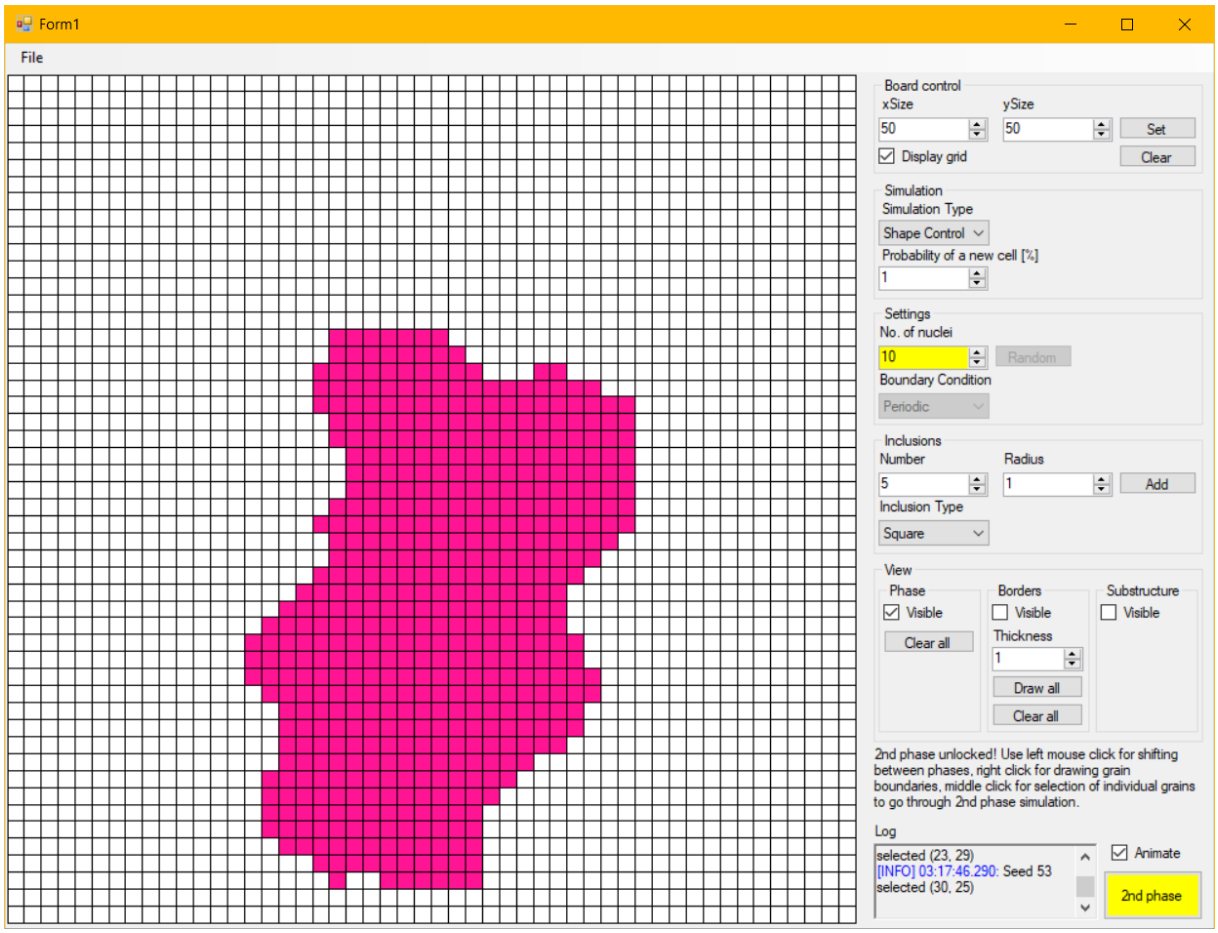

Figure 9 View with just phase 1 cells visible

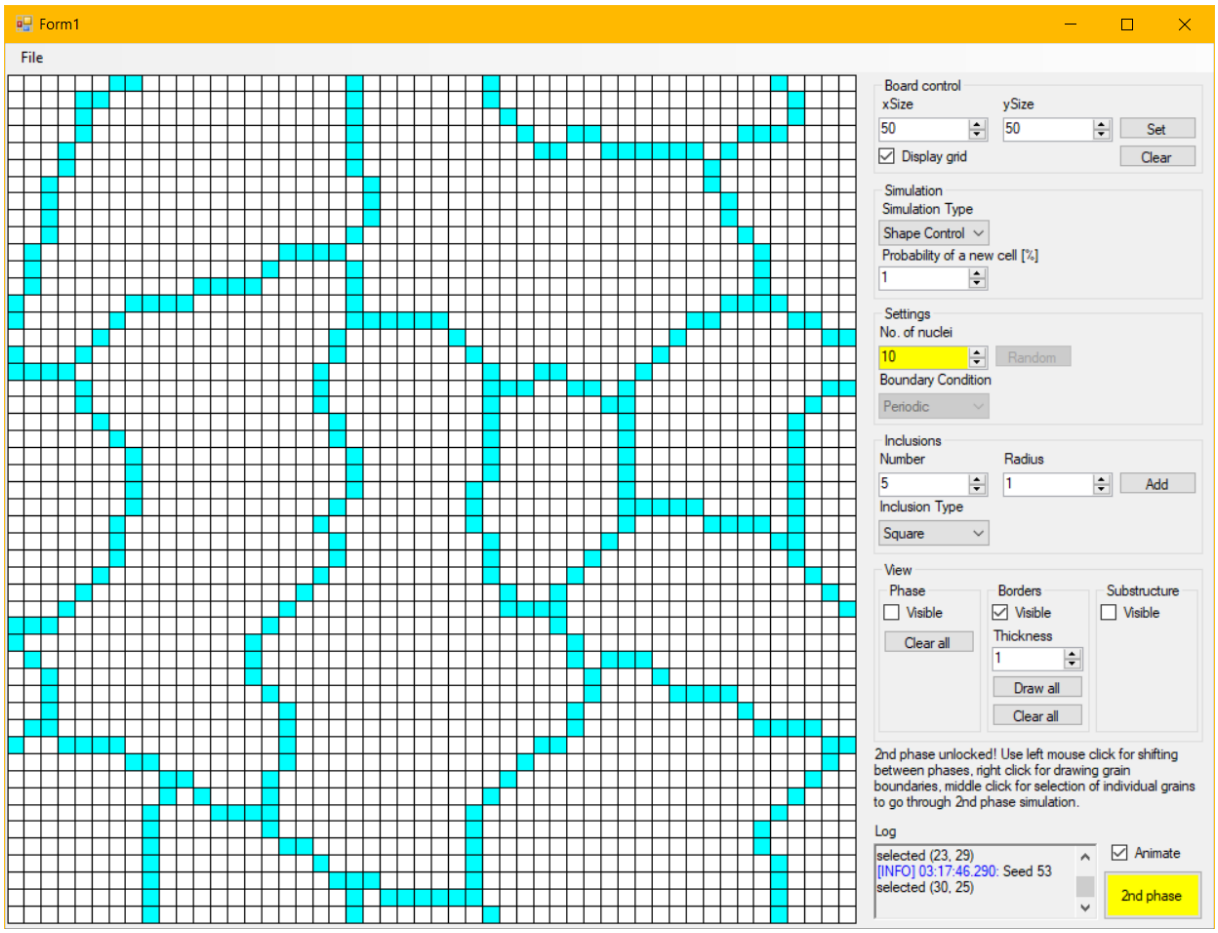

Figure 10 View with just grain borders visible

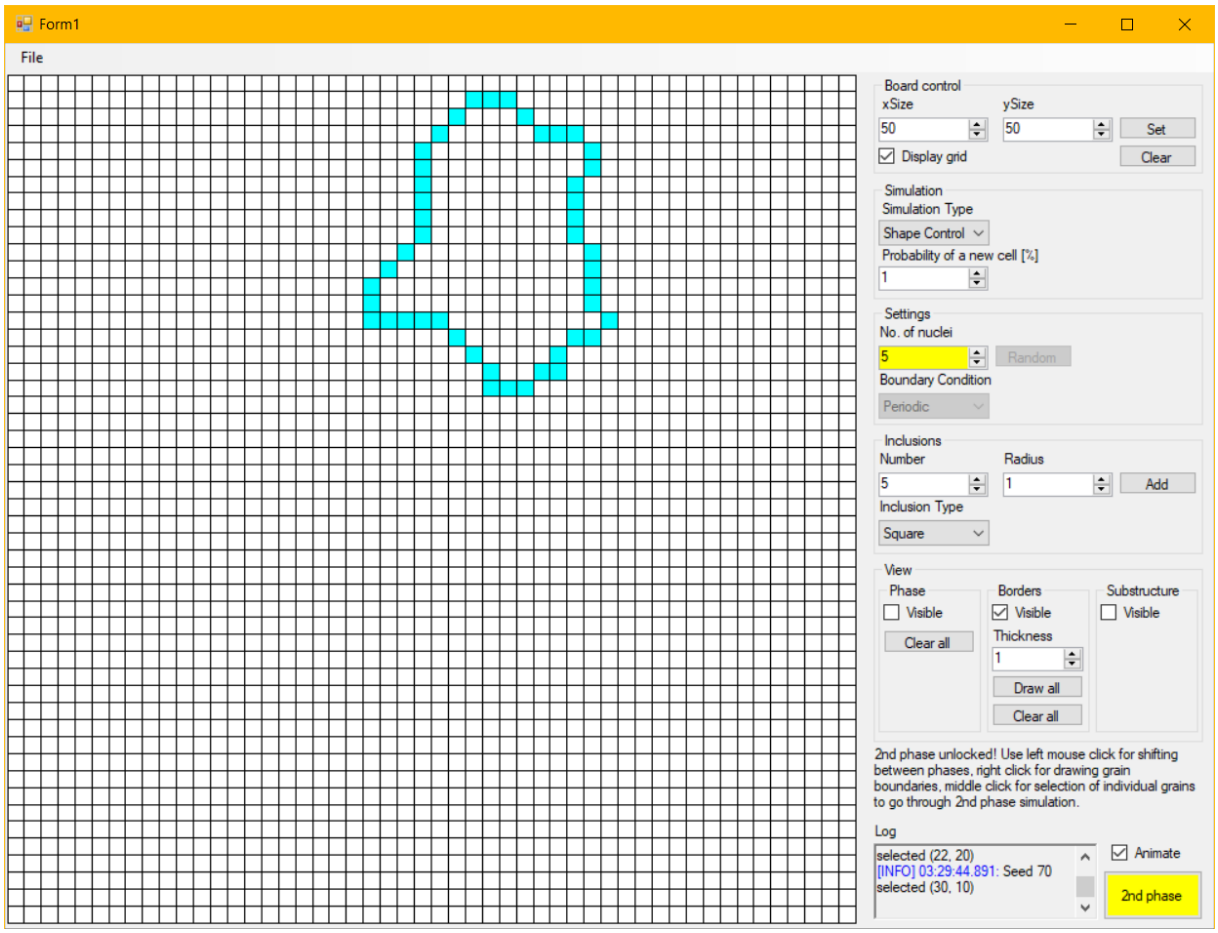

Figure 11 Border view for a single grain

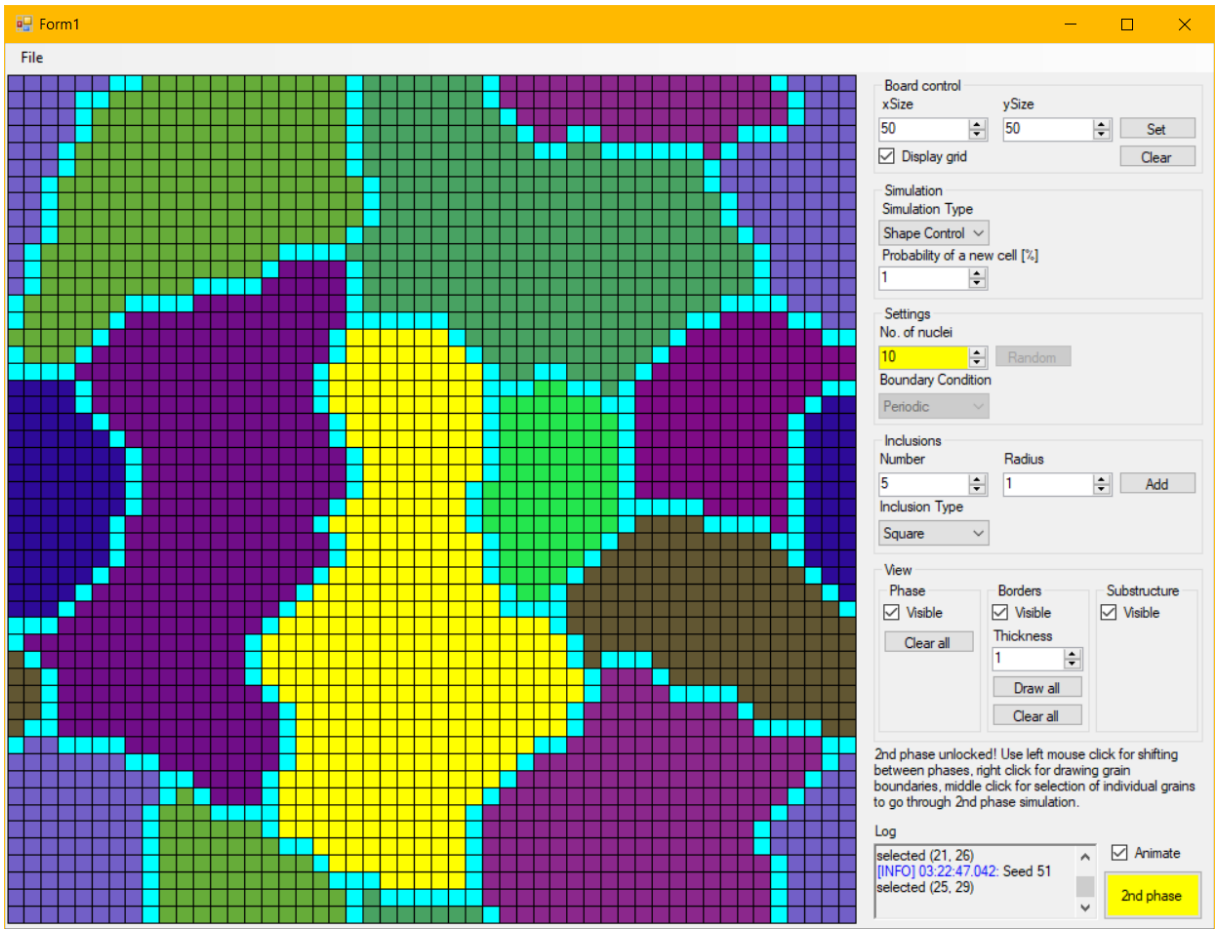

Figure 12 Selection of an individual grain

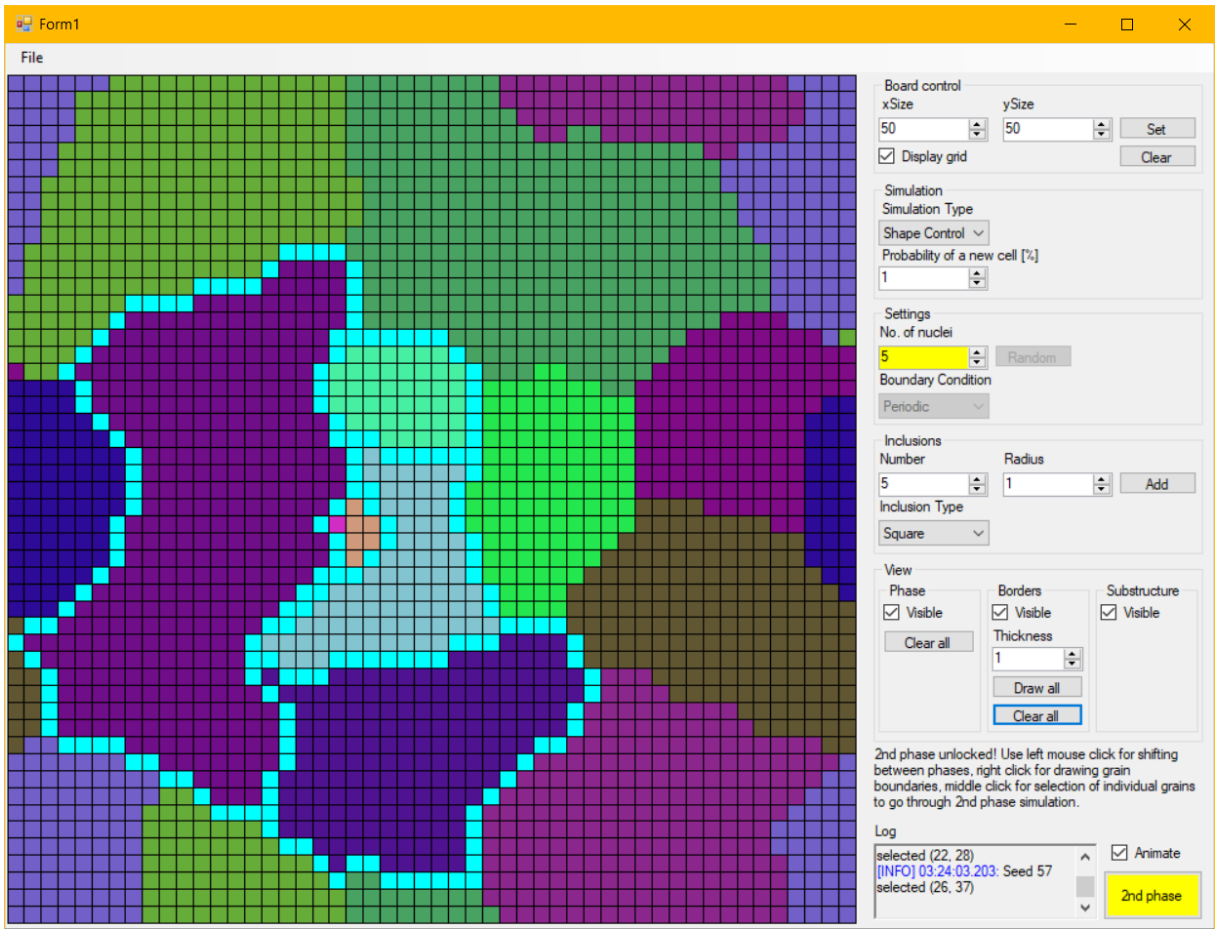

Figure 13 View after adding 5 new seeds in the place of the selected grain

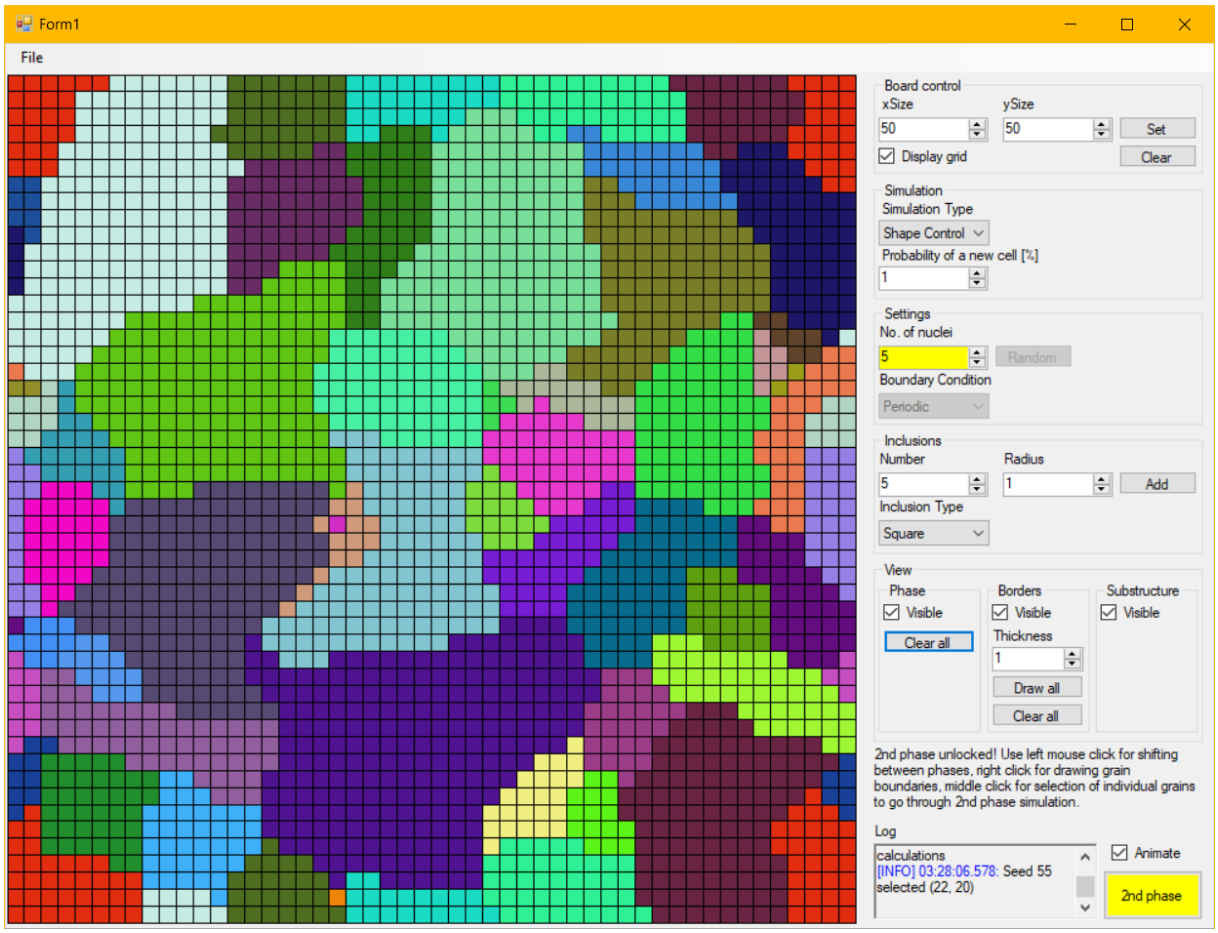

*Figure 14 View after running **2nd phase simulation** for all the grains*

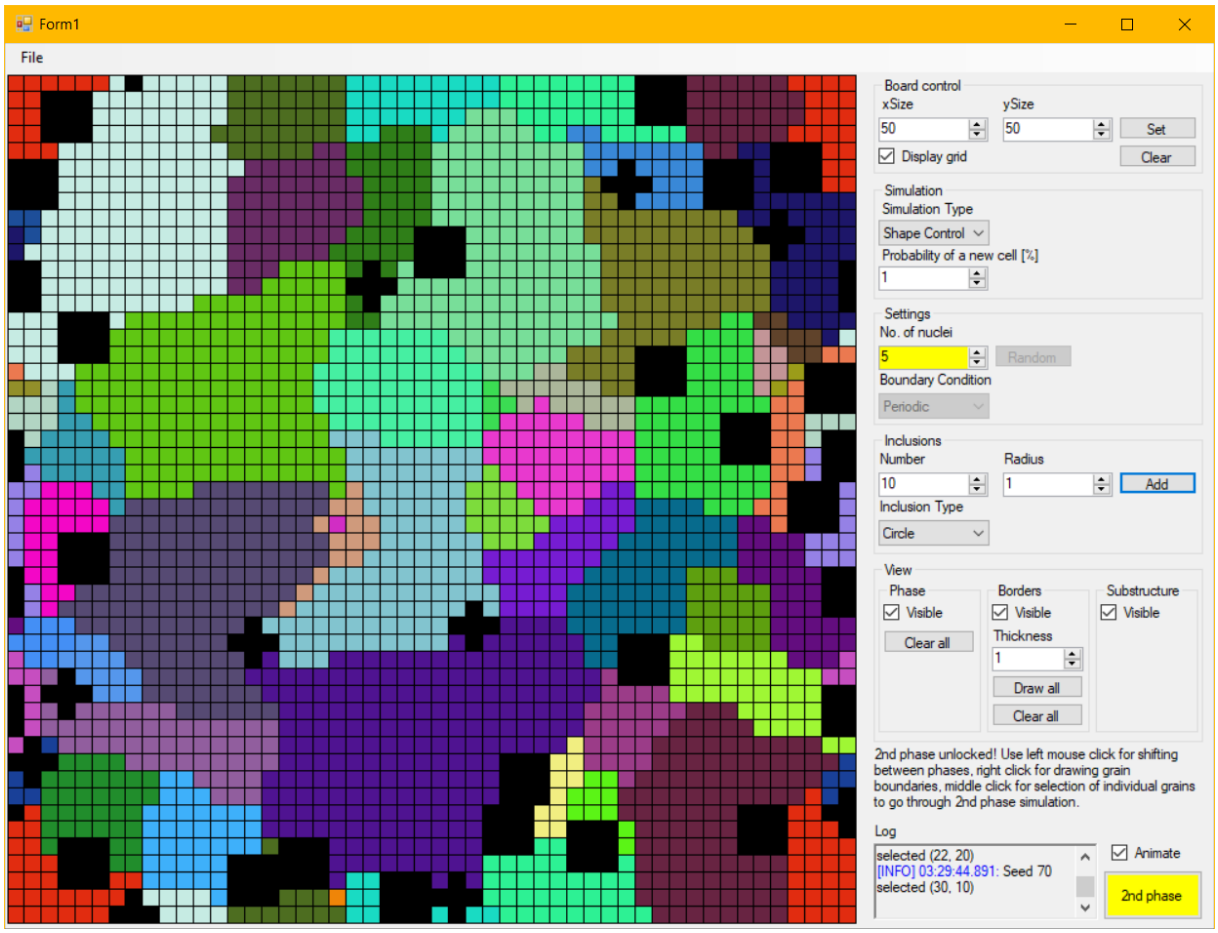

*Figure 15 Adding **Square** and **Circle** inclusions after finished simulation*

5. Table of figures