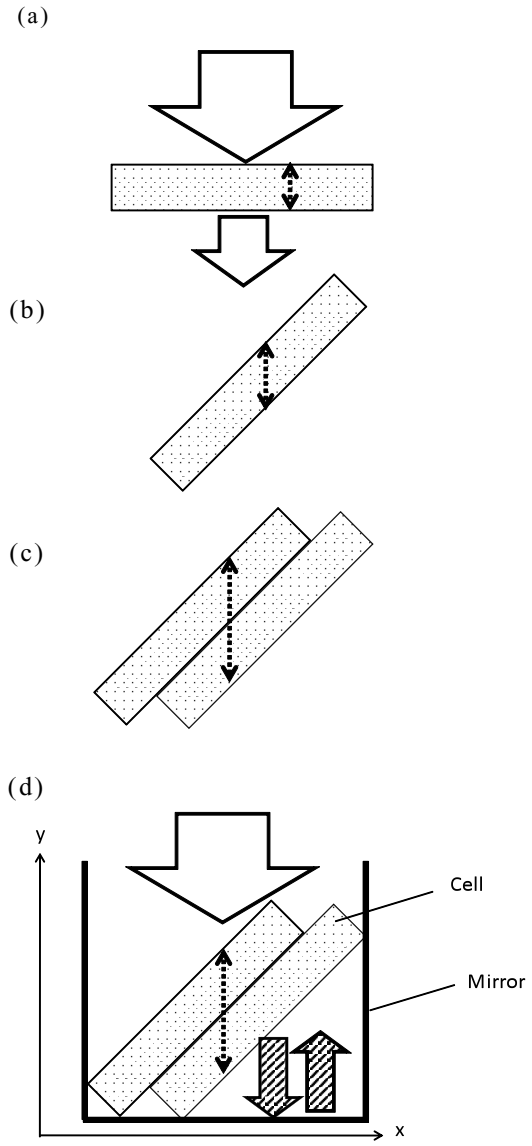

Fig. 1. Schematic diagram of arrangements of solar cells. Dotted rectangles: solar cells, white arrow: incident light, dashed arrow: optical path length, hatched arrows: transmitted and reflected light. (a) Horizontal arrangement. (b) Inclining arrangement. (c) Inclining with stacking. (d) Combination with side and bottom mirrors.

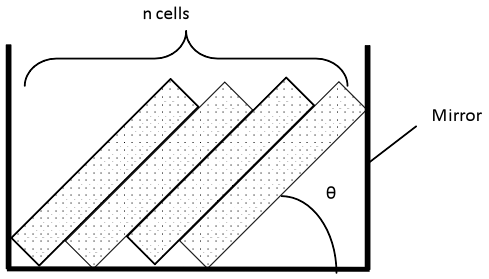

Fig. 2. Schematic diagram of a typical arrangement used for the simulation.

ing uniformity in z-direction.

The simulation program was developed using VisualBasic 2008 (Microsoft corp.). The program flowchart is shown in Fig. 3. The accuracy of the internal valuables depends on the limitation of the digit number of the valuables. It was confirmed that the accuracy was sufficient in comparison with the accuracy of experimental data used in the simulation. Figure 4 shows a screenshot of the program.

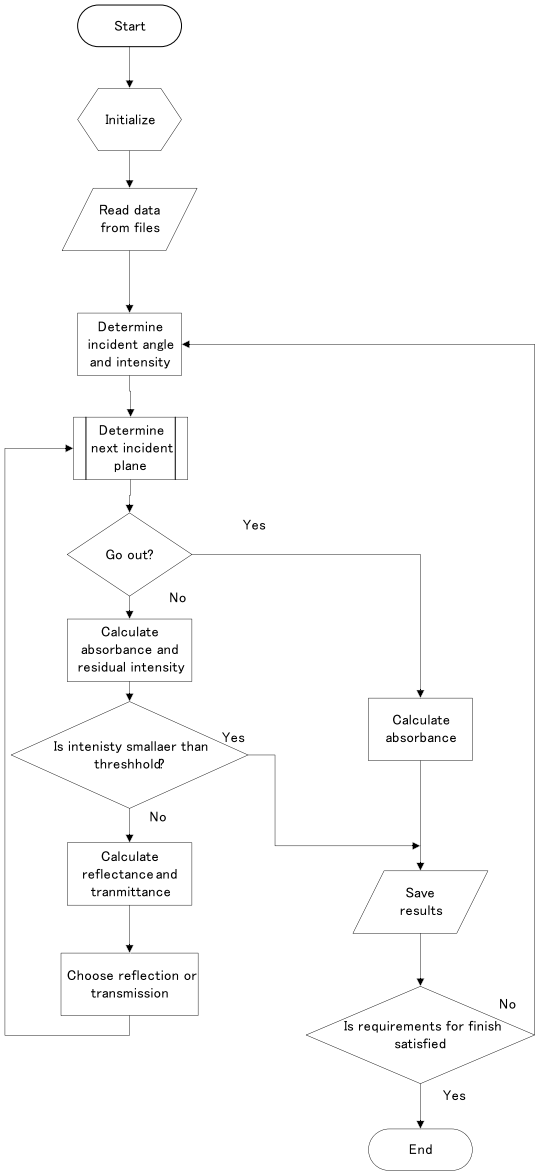

Fig. 3. Flowchart of the simulation program.

3.2 Data used in the simulation

The input data for the simulation are optical constants of the materials used in the DSCs, cell sizes and solar spectrum. Optical constants were calculated from experimental data, as shown in Fig. 5. The cell size was set to equal to that in the experiments described in the next section. The AM1.5 spectrum, which is the standard of the solar spectrum and intensity on the surface of the earth (ASTM standard, direct+circumsolar of ASTM G173-03 Reference Spectra data from SMARTS v. 2.9.2 (NREL)) was used.

4. Experiments

4.1 Materials and structure of the cells

Nanopowder TiO_2 of 20 nm in average diameter, a red dye and an electrolyte containing I^-/I_3^- redox couples were