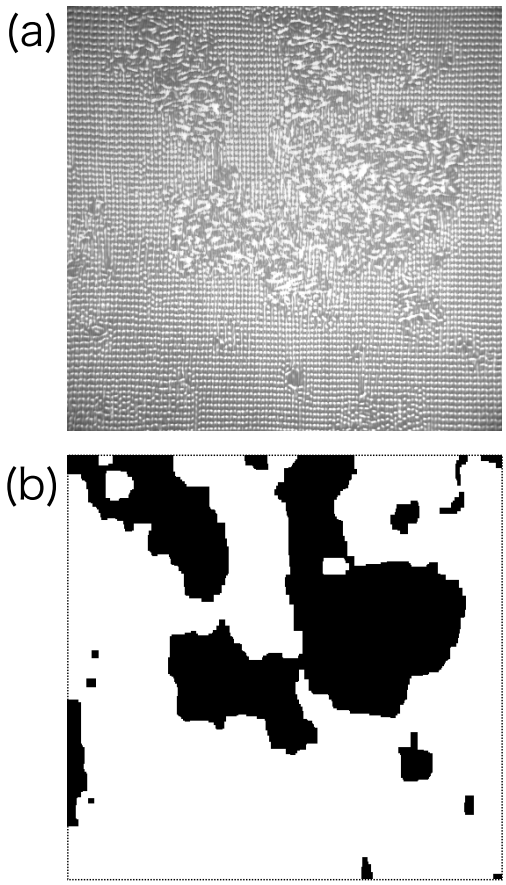

Fig. 3. Spatiotemporal intermittency of a defect-lattice type. (a) $u(x, y)$. (b) $\delta(x, y)$ obtained from (a). The ordered area (defect lattice) where $\delta(x, y) = 1$ is colored white, and the turbulent area where $\delta(x, y) = 0$ is colored black.

with shift s_1, $\delta(x, y)$ of the whole system can be obtained. Figure 3 shows a typical example of $\delta(x, y)$ of the defect-lattice type. In contrast, for the grid-pattern type, a similar evaluation is made for a 2D small area, because the fundamental order structure is a section of the grid. Figure 4 shows a typical example of $\delta(x, y)$ of the grid-pattern type.

4. Defect Turbulence

Defect turbulence (Fig. 5(a)) is a type of spatiotemporal chaos in which topological defects are generated as a result of fluctuations of the normal rolls. This is regarded as the state in which the position of convection rolls in the normal roll is fluctuating in the x-direction. The pattern of defect turbulence can be described as

$$u(x, y, t) = R_0 \cos[q_0 x + \alpha(x, y, t)], \qquad (7)$$

because the position of the roll is represented by the phase. Actually, the amplitude is also a function of (x, y, t). However, it can be regarded as the constant R_0 in Eq. (7), because the amplitude is nearly constant except that it becomes zero at a defect. Thus, important properties of defect turbulence are included in $\alpha(x, y)$. A topological defect generated as a consequence of roll fluctuations corresponds to a singular point of the phase $\alpha(x, y)$.

$\alpha(x, y)$ can be obtained by a method called "complex demodulation". The details are described in Appendix

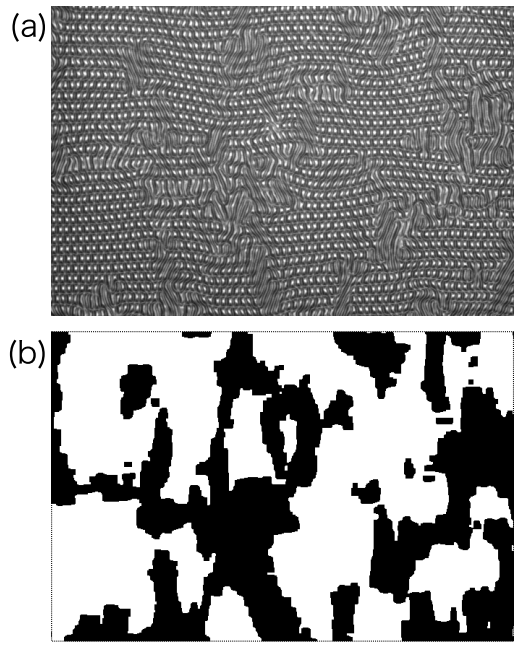

Fig. 4. Spatiotemporal intermittency of a grid-pattern type. (a) $u(x, y)$. (b) $\delta(x, y)$ obtained from (a). The ordered area (grid pattern) where $\delta(x, y) = 1$ is colored white, and the turbulent area where $\delta(x, y) = 0$ is colored black.

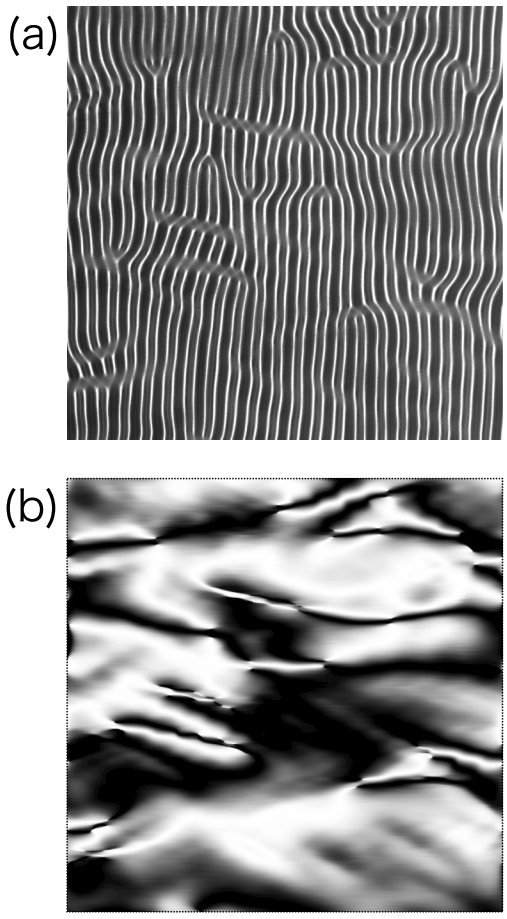

Fig. 5. (a) Defect turbulence. (b) $\sin(x, y)$ obtained from (a). This is displayed in gray-scale with $\sin(x, y) = 1$ as white and $\sin(x, y) = 0$ as black.