New view of sunspots revealed by Hinode

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The sunspots are the most distinctive manifestation of the solar magnetic activity. They form active regions on the sun that produce a variety of explosive phenomena to supply vital disturbances into the space environment. The growth and decay profile of sunspots is thus a crucial importance for the study of the space weather. Our aim of studying the sunspot is to understand their internal structures and the mechanism that governs the evolution of the sunspots. For this purpose, the Solar Optical Telescope (SOT) aboard Hinode provides us with unprecedentedly useful data sets in a sense that it has a high spatial resolution, a high precession of the magnetic field measurement and the continuous coverage of data without the day-night cycle.

The sunspots have highly structured magnetic fields associated with small scale plasma flows. The SOT resolved the elementary structures of sunspots for the first time, which should serve as an important clue for understanding the 3D structure of the sunspots. Small scale activities are also fond in the upper layer of sunspots, which may cause the injection of energy into the overlying corona. A number of magnetic features are observed in the photosphere moving away from the sunspot, which should be related to the decaying process of the sunspots. Distinctive oscillations are found in sunspot, which provides information of the internal structure of the sunspots. We present the new views of the sunspots provided by the SOT/Hinode and discuss the approaches for understanding the sunspot structure and their evolutions for the future contributions to the space weather prediction.