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Properties and Classification of Diamond-Like Carbon Films

Abstract: Diamond-like carbon (DLC) films, which are amorphous, contain sp^2 hybridized carbon corresponding to a graphite structure and sp^3 hybridized carbon corresponding to a diamond structure. DLC films have been utilized as the coating material on cutting tools, molds, food vessels, and medical devices owing to their excellent properties: high hardness, low friction coefficient, gas barrier, chemical inertness and biocompatibility. Thus, huge market has been expected in the DLC industry and various DLC films are synthesized and utilized in plenty of purposes. On the other hand, because the structure of the DLC film is amorphous, its definition is ambiguous and difficult to evaluate. Systematic knowledge on DLC films has not been obtained at all, such as which carbon film can be called a DLC film, what physical properties of DLC films exist, what kind of evaluation is objectively convincing to others, and which DLC film is suitable for what kind of application. Therefore, there were major issues in protecting intellectual property rights, evaluation criteria for producers, and selection criteria for users. To solve these issues, it was necessary to establish criteria to evaluate structures and properties of DLC films and to classify DLC films with various compositions and properties. In 2006, a NEDO project in Japan evaluated 58 types of DLC films for about 20 test items, including structure, mechanical properties, chemical properties, biocompatibility, and so on. Based on the results of this round-robin test, standardization of the classification of DLC films was promoted, and an international standard (ISO 20523: Carbon based films - Classification and designation) published in 2017, in addition, several ISO standards have been established for evaluation methods of DLC films

Keywords: diaond-like carbon, structural analysis, sp^2/sp^3 ratio, hydrogen content, ISO

Biography: Dr. Kazuhiro Kanda is a professor at the Laboratory of Advanced Science and Technology for Industry, University of Hyogo, which has a synchrotron radiation facility for soft X-rays, “NewSUBARU”. He specializes in the material properties of thin films and surfaces, with particular emphasis on structural analysis using quantum beams (synchrotron radiation, high-energy ion beam, positron beam, etc.). In recent years, his research has focused on amorphous carbon films, and he contributed to the ISO standardization of DLC films as a member of the international standardization project of the Ministry of Economy, Trade and Industry in Japan.