論 文 内 容 の 要旨

Abstract of Dissertation

Name　岡部　知行

In recent years, due to the remarkable development of science and technology, products with various functions that could not be realized until then have been developed and manufactured, and are widely sold all over the world. It is the functional materials that utilize the characteristics of materials such as semiconductors, optical glass that determine the functions of such products. However, recently, product accidents caused by raw materials and parts have frequently occurred due to the occurrence of defects (silent changes) due to unintended changes in materials at the manufacturing stage, damage/fracture of materials, and deterioration over time. Therefore, it is important to carry out risk management related to material changes and failure mode analysis related to materials by front loading from the concept design stages of products to prevent them. Therefore, in this study, we propose the failure mode analysis (risk assessment) methods ”modified DRBFM(Design Review Based on Failure Modes)” and ”design deviation method” for materials.

The modified DRBFM is a method that extends the logic of DRBFM by introducing the concept of restriction specifications in risk assessment into DRBFM. The modified DRBFM makes it possible to effectively derive the correspondence between design changes/environmental changes and damage/fracture mechanisms of materials. The modified DRBFM is applied to the failure mode analysis comparison exercise (FMEA(Failure Modes and Effects Analyses)) and modified DRBFM) for the objective lens of the virtual laser optical system, we verified whether the failure mode could be extracted effectively for effectiveness of modified DRBFM. The DDM (Design Deviation Method) is the failure mode/risk evaluation method for materials that can deal with the problems clarified through the verification of the modified DRBFM. DDM consists of the procedures of ”set the deviation patterns of design deviation in the restriction specifications”, ”correspond the deviation patterns of the stress/strength parameters in the design

deviation patterns and the stress-strength model (SSM) by the correspondence table", "deriving the damage/fracture modes of materials from the SSM deviation patterns and deriving it as the failure mechanisms of the functions". The DDM can logically derive the failure modes due to damage/fracture of materials from the expected changes in the restriction specifications. The DDM is applied to failure mode analysis comparison exercises (FMEA, DRBFM, DDM) for a virtual laser treatment system. The effectiveness of DDM was verified whether the damage/fracture mechanisms and failure modes caused by material properties could be effectively extracted.

In addition, in the derivation of failure modes based on damage/fracture of materials, there is a possibility that the results may change depending on the knowledge of the failure mode analysts such as material strength, and problems in due to selection mistakes etc. In order to solve this problem, using support vector machine of machine learning methods is constructed in method for determine the validity of the derived damage/fracture modes by analyzing the similarity between the correspondence table prepared in advance and the input results of the failure mode/risk evaluators. The validity of the discriminant analysis results was considered by applying the failure mode discriminant analysis method using SVM(Support Vector Machine) to the exercise results of DDM and analyzing the exercise results.