Non-linear model for absorption in SiO$_2$ optical fibres: Transport of concentrated solar energy

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Received 12 January 2000

Abstract

In order to determine the maximum solar energy than can be transported using SiO$_2$ optical fibres, analysis of non-linear absorption is required. We propose a model based on Maxwell's equations and the Drude–Lorentz theory to determine the non-linear absorption for the maximum possible concentration ratio for circular concentrators. The relation between the electric susceptibility and the refractive index with microscopic parameters is provided. To solve the non-linear model for absorption experimental parameters are used. Our results estimate that the average value over the solar spectrum for the non-linear extinction coefficient for SiO$_2$ is $k_2 = 10^{-29}$ m$^2$ V$^{-2}$. With this result we conclude that the non-linear part of the absorption coefficient of SiO$_2$ optical fibres during the transport of concentrated solar energy achieved by a circular concentrator is negligible. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: SiO$_2$ Optical fibres; Non-linear absorption; Non-linear extinction; Concentrated solar energy transport

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0927-0248/00/$-$ see front matter © 2000 Elsevier Science B.V. All rights reserved.
PII: S0927-0248(00)00218-X