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## Two carrier band transport in InP:Fe under single beam illumination

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Indium Phosphide is a material of primary relevance in the field of opto-electronics since it supersedes conventional materials such as AsGa for electron mobility and heat conduction for instance. It is often doped with iron to reduce its conductivity and enhance its light dependent conduction properties (1).

Indium Phosphide is well known for its two carrier band transport conduction mechanism, where both electrons and holes play a significant role. Its transport mechanisms have been heavily investigated, especially in the dark. Light induced charge transport, on the contrary, has been investigated at the end of the XX<sup>th</sup> century as far as periodic illumination stemming from beam interference is concerned (2-4). More recently, non periodic illumination was tackled. Both have shown the existence of a particular intensity, named the *resonance intensity*, at which charge transport is enhanced and around which it changes behavior(5). Both have in common the small modulation hypothesis where light intensity is assumed not to deviate too far from its mean value.

InP:Fe being an electro-optic material, this resonance mechanism has been shown to be at the heart of a light induced refractive index modulation, leading to light self-focusing (6). However, a one beam illumination is far from the small modulation hypothesis. Experiments indeed show that the very notion of resonance intensity no longer holds(7-8). They also show a behavior-reversal intensity. Its value is different from that of the resonance intensity, but remains to be explained (9).

We attempt here a theoretical study of the two carrier band transport model in InP:Fe, in the simplifying framework of one single space dimension alongside the time dimension. Our original approach is to rule out all conventional approximations, aiming to justify each of them mathematically with precise numerical values. Once this is done, we go on to a simplified model of two carrier transport in InP:Fe, for which basic simulation will be undertaken and checked against experimental results. The mathematical method undertaken here is known as multi-scale modeling (10). It is needed

because of the presence of largely varying orders of magnitudes in the parameters of the two carrier band transport model.

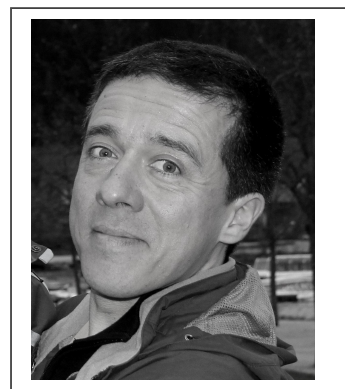
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## Biography

Nicolas Fressengeas completed his PhD in physics in 1997 with a Non Linear Optics speciality in the University Paul Verlaine, Metz, France. He then joined Supélec and the laboratory Matériaux Optiques, Photonique et Système (Optical Materials, Photonics & Systems) where he obtained his habilitation to supervise research in 2001 from the same university. He joined that same university on a Professor position in 2004 which he still holds.

His main research interests are in the field of nonlinear optics and thus numerical analysis applied to optical and non linear materials. In this aim, he took part in several French country level programs associated to the Lorraine region, in the field of parallel computing.



### **Session:**

Modelling and simulation of materials