5 Summary and outlook

In the thesis work, combining with polysiloxanes based EOCB project: Prospeos (worldwide first industrial production of EOCBs within the frame of BMBF projects) optical aspects and mechanical aspects which mainly determine EOCB products' operation stability and reliability are analyzed and focused in detailed. Basic quality factors in the two aspects, including the influences of the materials, processes, and environments etc. on the optical, mechanical and thermal performance of the final EOCB product are identified and studied respectively in order to assure the EOCB products' quality and long-term reliability. Additionally, some basic quality monitoring methods as well as test and optimization procedures are identified and verified as well.

In details, first with respect to optical aspects of EOCBs, the impact factors on refractive indices of polysiloxanes materials were identified and verified in terms of bandwidth request from our customer and market requests. Furthermore, the absorption loss of polysiloxane in the spectral datacom and telecom region of 600 - 1600 nm was analyzed and summarized to be scattering loss and absorption loss due to molecular vibrational overtone and combination bands of the CH containing groups. In terms of the observed positions of fundamental, overtone and combination bands of CH containing groups' vibrations in the mid-IR and NIR spectra, anharmonicity constants including normal harmonic vibration frequencies have been determined and two empirical equations for estimating the significant intrinsic absorption loss wavelengths has been presented in terms of core and cladding two different PDMS based polymers. The results agreed well with the experimental data. Moreover, we derived two empirical equations between integral band strength and the intrinsic absorption loss based on the NIR spectral data of cladding and core two different PDMS based materials, which can be exploited also for the limit estimation of the optical loss in deuterated or halogenated such siloxane-based polymers applied in different datacom devices. Additionally, the PDMS waveguides were fabricated with low optical insertion loss at 850 nm and

1300 nm respectively, and of high thermal stability were also verified, which prove indeed two components thermal curing PDMS are very promising in production of datacom devices. In the end of this part, the impact factors on optical properties of EOCB products from process aspects were identified as well as the proposal of the optimum process conditions.

In the following, with respect to mechanical aspects of EOCBs, based on study of polysiloxanes curing mechanism, a novel self-packaging method of PDMS based optical waveguide layers laminated to standard PCB carrier materials has been identified and experimentally verified. Through experimental verification, it was found that the mechanical stability of the fabricated EOCBs is limited not by the interfacial bonding strength between optical layer and PCB layers but by the intrinsic mechanical stability of the PDMS material at about 1.35 MPa. Additionally, in part of design for reliability, ccombining general PCB test methods together with standard test methods for optical components applied in telecommunications, one reasonable reliability test procedure has been defined and practically implemented to check the optical and mechanical stability performances of EOCBs as well as the determination acceleration factors and sample sizes. After tests, it was found, except the good mechanical stability the packaged EOCBs exhibit low and stable optical loss values (<0.1 dB/cm) even at extreme environmental conditions, e.g. 260 ^{o}C.

In the future, apart from the costs control in EOCB production line e.g. from materials and processes etc., how to manage and control efficiently the identified quality factors with low cost in EOCB production will be very worthy expecting in terms of those basic quality requirements. Moreover, a topic, whatever must be further examined and considered in serious in the future, is just the realization of an appropriate and compatible passive coupling and packaging solution, which achieves optical loss as small as possible. Along with Prospeos project, a first worldwide foundation-stone of EOCB and its production was built. However in order to fully industrialize it and produce the eligible and reliable EOCB products, it is very important to establish series of inspections standards and evaluation criterions with respects to EOCB products.