or a focal length correction layer can be applied to a transparent cover substrate (e.g., wafer), which then is diced into singulated covers each of which has at least one of an optical filter or focal length correction layer on its surface. The focal length correction layer may be, for example, a focal flange length (FFL) correction layer. The FFL sometimes is referred to as a flange focal distance. The singulated covers, each of which includes an optical filter layer or a focal length correction layer on its surface, then can be integrated into any of the fabrication techniques described above (e.g., FIGS. **3**A-**3**E; FIGS. **4**A-**4**C; FIGS. **5**A-**5**E; FIGS. **6**A-**6**C; FIGS. **7**A-**7**E; FIGS. **8**A-**8**D; FIGS. **9**A-**9**D; FIGS. **10**A-**10**B; etc.).

Including a FFL correction layer can be particularly advantageous, for example, for image sensor applications. Thus, in some instances, the transparent cover may include a replicated lens on one side only or, in some cases, may not include a replicated lens on either side. An example is illustrated in FIGS. **23**A and **23**B, which show multi-channel modules **500**A and **500**B, respectively.

Modules **500**A and **500**B of FIGS. **23**A and **23**B include an image sensor **522** supported on a PCB or other substrate **524**. Image sensor **522** has optically sensitive regions **523** that are surrounded laterally by a spacer **528**, which also serves as sidewalls for the sensor-side of the module. Side edges of the transparent covers **526** are laterally surrounded and covered by the non-transparent material (e.g., an epoxy with carbon black). In some cases, the non-transparent material surrounding the transparent covers **526** is the same material as the spacers **228**. Transparent covers **526** can be composed, for example, of glass, sapphire or a polymer material, and are separated from image sensor **522** by spacer **528**. In the illustrated examples of FIGS. **23**A and **23**B, the object-side of each transparent cover **526** includes an optical filter **530**, which can be implemented, for example, as a thin coating. Likewise, the sensor-side of each transparent cover may include a FFL correction layer **532** to correct for the channel focal length. The thickness of the FFL correction layer **532** in each channel may vary from the thickness of the FFL layer **532** in another channel. In some cases, only some of the channels have a FFL correction layer.

Non-transparent material **539** may extend beyond the top of transparent covers **526** near their edges. Depending on the implementation, non-transparent material **536** that covers the sidewalls of the transparent covers **526** can be the same as, or different from, the material of the spacer **528** and/or the non-transparent material **539** that extends beyond the top of the transparent covers **526**. The exterior side of PCB substrate **524** can includes conductive contacts, which can be coupled electrically to image sensor **522** by way of conductive vias extending through substrate **524**.

The modules **500**A, **500**B can include one or more optics assemblies **550**. The optics assemblies can be attached to an assembly **540** that is composed of the transparent covers **526** (including a lens element, an FFL correction layer **532** or a filter layer **530**, if present) and non-transparent walls/spacers **528**, **536**, **539**. Each optics assembly **550** can include, for example, a stack of one or more injection molded optical elements (e.g., lenses) **552** placed in a lens barrel **554**. In some cases, an array of injection molded lens stacks can be provided collectively for more than one optical channel (see FIG. **23**A), whereas in other implementations, a separate lens stack is provided for each respective channel (see FIG. **23**B).

Multiple assemblies **540** including transparent covers **526** (together with the FFL correction layer **532** and/or the filter layer **530**) and non-transparent walls/spacers **528**, **536**, **539** can be fabricated as part of a wafer-level process. In some implementations, a channel FFL correction layer is provided on one side of a transparent wafer. The FFL correction layer may be composed, for example, of a glass or polymer material, and can be applied, for example, by spin coating, spraying or sputtering. An optical filter layer may be applied to the other side of the transparent wafer. The spacers and walls for the modules can be formed using the techniques described in detail above (e.g., replication or vacuum injection, as well as trench formation and filling of the trenches with non-transparent material in some cases). Transient substrates (e.g., UV dicing tape, a PDMS substrate, a glass substrate, a polymer wafer) can be used to support the structure during the foregoing steps. In some cases, a lens may be replicated on the surface of the optical filter layer. Further, if an optical filter layer is not provided on the transparent wafer, then in some cases, a lens may be replicated directly on the surface of the transparent wafer.

Next, optics assemblies (i.e., lens stacks) can be attached to the object-side of the spacer/optics/embedded transparent cover assemblies. This can be accomplished either on a wafer-level scale or by attaching individual lens stacks to the spacer/optics/embedded transparent cover assemblies. Next, the focal length (e.g., FFL) of each optical channel can be measured and compared to a specified value. If the measured FFL for particular channel deviates from a desired value, the FFL correction layer can be removed selectively in that channel to correct for the FFL value. Photolithographic techniques can be used, for example, to partially or entirely remove the FFL correction layer, as needed. Since the channels may have different FFL values, different amounts of the channel FFL correction layer may be needed to achieve corrected FFL values for the various channels. For some channels, no FFL correction may be needed. In other cases, a portion of the channel FFL correction layer may be removed. In yet other cases, no portion of the channel FFL correction layer may be removed. Thus, depending on the implementation, the channel FFL correction layer may be present for all of the channels or for only some of the channels. Furthermore, the thickness of the final channel FFL correction layer may vary from one channel to the next, depending on the amount of FFL correction needed in each channel.

The wafer-level structure (including the spacers, transparent covers whose side edges are surrounded and covered by non-transparent material, and optics assemblies) then can be separated into individual assemblies, each of which includes, for example, an array of optical channels. Each of the separated assemblies then can be attached to an individual image sensor assembly (i.e., a PCB substrate on which is mounted an imager sensor).

In some implementations, it may be desirable to provide an optical filter **530**A directly on the active photosensitive regions **523** of the image sensor **522**. Such filters can be provided, for example, instead of the filters **530** on the transparent cover **526**. This arrangement may be useful, for example, where a lens is replicated on the surface of each transparent cover **526**.

Each of the modules of FIGS. **23**A and **23**B includes multiple optical channels. Single modules that include similar features can be provided as well. An example of such a module **500**C is illustrated in FIG. **23**C. The sidewalls of the transparent cover **526** as well as the sidewalls of the optical filter **530** are covered by the non-transparent material of the spacer **228**. The module **500**C also includes an optics assembly implemented as a stack of one or more injection molded optical elements (e.g., lenses) **552** placed in a lens