



Process Simplification on Integration of UV Cure Machine with Tape Saw Singulation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Strips that have undergone tape saw singulation will not be completed without the ultraviolet (UV) curing process. To detach the units from the tape, the singulated strips have required further assistance to be loaded for UV cure. Otherwise, hard-to-pick units will be the outcome and sticky residues were usually observed to be attached on the units. Since tape sawn strips requires UV cure, suppliers were asked to engage on upgrading their machine to equip the singulation machine with UV cure. The principle is that after sawing, the singulated strips will be washed and dry normally at the spinner. Then instead of unloading the singulated strips, the machine will pass it first to the inline UV cure machine and then unload when successfully completed the whole process. Through adding the UV curing process in the package singulation sequence, singulated strips unloaded are now ready for the next succeeding process. That way, it would be much help to lessen the handling of sawn strips from one machine to another. The introduction of inline UV cure has simplified the process by automation which increased the security of the units' quality as well as the productivity of manpower.

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1. INTRODUCTION

The singulation process is where the separation of units from a whole strip was done. Tape saw singulation is used to process new and more complex products as the process uses resources that are not needed to be tailored fit and fabricated with the strip configuration. Important to note that with new and continuous technology trends and development, assembly manufacturing challenges are inevitable [1-5]. Tape saw singulation is beneficial on new packages under qualifications and evaluations. Ultraviolet (UV) tape was used to mount the strips that would undergo tape saw singulation.

UV tapes are strong adhesive film that holds firmly in dicing and singulation processes. After the UV irradiation, adhesive strength decreases significantly and easily able to de-tape nor pick up the units after singulation. Shopfloor has been using two separate machines to singulate or cut individually the units from a whole strip. One is the tape saw singulation machine, and the other is the UV curing machine. Operators' activity was to unload the tape sawn units from the singulation machine, and then travel to the UV curing area to load the singulated strips. Aside from non-value-added activity from the operators, products were put in risk with travelling and manual loading.

The authors have found an opportunity to study the workability of a simplified process given with the new singulation machine technologies being offered in the market. With the study, the authors would explore the performance of a tape saw singulation machine with integrated UV cure machine in contrast with the current practice of processing using two separated machines.

2. METHODOLOGY

The authors have explored first the importance of UV curing process with regards to the tape saw singulation. Next that was verified was the current production practice on processing the strips at tape saw singulation. Verifying the current practice followed by understanding the

capability of new tape saw singulation machines. Last step that conducted on this study was to validate the effectiveness of simplified process between tape saw singulation and UV curing process. The authors have also validated for opportunity of savings with the process simplification.

2.1 Importance of UV Curing

Complex and new devices were processed at tape saw singulation where the strips were mounted on a singulation frame that was attached with UV tape prior submission to cutting. Units that were cut with tape saw singulation demanded to undergo UV curing procedure to cure the tape adhesive.

UV tape was made to have high tactility when cured to avoid unit fly off and unit dislodge during singulation. Tactility was reduced upon UV curing after the strip has been singulated.

Curing of the adhesive weakens the tactility of the tape with the units, thus allowing the units to be demounted from the tape and proceed on unit pick and place. Tape that was not cured resulting for hard-to-pick units.

The process flow of tape saw singulation is shown in Fig. 1. Process flow started with frame mounting where UV tape will be covered on the singulation frame ring and then the strips will be mounted on the UV tape inside the frame ring. The process will be followed by singulation process wherein Mounted Strips will be cut from one strip into single unit. UV curing will follow where singulated units still mounted on UV tape will undergo UV curing to remove tape tackiness on the units to be ready for pick and place where the units will be detached on the tape and then placed on the tray unit pocket.

UV curing process step is found to be mandatory when strips were processed under tape saw singulation machine. Nature of UV tape was needed to be cured after singulation for the units to be detached and separated upon proceeding to the downstream process at assembly.



Fig. 1. Tape saw singulation process flow

2.2 Stand Alone Singulation and UV Cure Machines

Production uses several machines to process the strips at tape saw singulation which is the tape saw singulation machine, and the separated UV curing machine. Shopfloor operators travels from the one machine to another. Unloaded strips from singulation was transferred and manually loaded to the UV curing machine. After UV curing, operators manually arrange the strips back to the carriers in preparation with the next process.

The current practice was time consuming and requires effort from the operators. It was also risky that UV curing was skipped after singulation and will results on hard-to-pick units on the succeeding process. Risk of Lot mixing was also observed through the manual interventions for the lot. Fig. 2 shows the two stand-alone machines of saw and UV cure.

As UV curing was mandatory with the lots processed at tape saw, exploring the capability of new singulation machines that was integrated with UV curing was considered.

2.3 New Machine Capability for Integrated UV cure at Singulation

New tape saw singulation machines were offered to have integrated UV curing attached on the machine. The machine was developed to be capable of proceeding the sawn strips to UV curing before unloading on the strip carriers.

The machine was equipped with UV curing lamps under the onloading carrier area. After the strips has been sawn, UV cure would rise, and the strip picker would push the strips to the UV curing area instead of the carrier. After UV curing, the strip picker would pull the cured strips and then unload on the carrier.

The authors have found an opportunity on process simplification brought about by modern tape saw machine with integrated UV cure. Opportunity was to eliminate the risk of lot mixing and skipping process that was brought about by manual intervention of the operators. Productivity was also increased as travels between machines were also eliminated. Adding UV curing at saw was also found not to affect the units per hour produced as machine simultaneously saw one strip while UV cures another. The sawing machine integrated with UV cure us illustrated in Fig. 3.

Opportunity found on the capability of modern tape saw singulation machine needs to be validated for the effectivity. The authors have proceeded on validation if the performance of simplified process has similar response with the separated machines.

3. RESULTS AND DISCUSSION

Through the series of studies conducted on methodology, it has been found out that the performance of cured UV tape at pick and place using the simplified process has no significance on the performance produced on the separated stand-alone machines of singulation and UV cure.



Fig. 2. Separate machines of sawing and UV cure

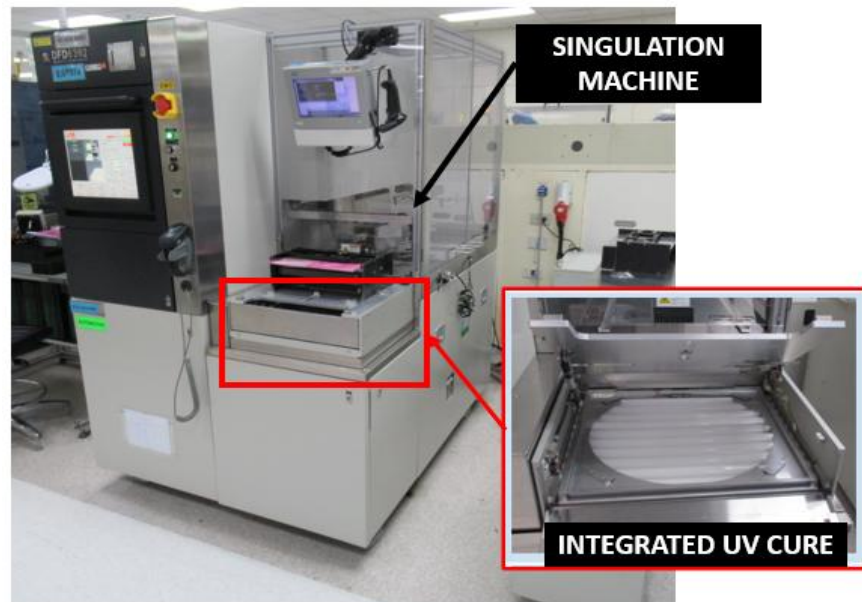


Fig. 3. Sawing machine with inline UV cure

Quad-flat no-leads (QFN) device has been used to evaluate both simplified (integrated) and conventional (separate) UV curing process, and both resulted with ease of unit detachment on the tape. Thus, both practices can be used for the strips that undergone tape saw.

Another benefit of the simplified process of UV curing was to lessen the operator travel time to transfer the sawn strips into the UV curing machine. Manual intervention of multiple loading and unloading of the strip to the carrier was minimized as well.

4. CONCLUSION AND RECOMMENDATIONS

With the results gathered in the study, the authors therefore conclude that the simplified process through the integration of UV cure with the tape saw machine is essential in terms of productivity. Manual interventions through loading and unloading were minimized and travelling from one place for singulation of the strip to another for UV curing was eliminated.

The authors also concluded that the performance of the simplified process was comparable with the conventional one where saw and UV curing machines were separated. Thus, simplified process is recommended specially for growing and evolving semiconductor companies.

Furthermore, it is recommended to explore other improvement for UV curing process and the tape saw singulation that are cost-effective. Works and studies in [6-8] focusing on the cutting method, design, and singulation process improvement, and learnings and discussions on UV tapes and curing in [9-12] would be of big help for further study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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